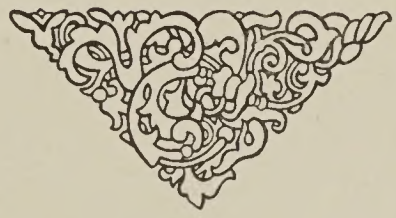
Strength Lightness and Rapidity in Fireproof Floor Construction

STRENGTH
LIGHTNESS
and RAPIDITY
IN FIREPROOF FLOOR CONSTRUCTION

WITH THE

METROPOLITAN FIREPROOFING COMPANY'S SYSTEM



KEYSTONE FIREPROOFING COMPANY

BOSTON NEW YORK PHILADELPHIA

MONTREAL TORONTO

Sixty Wall Street Building
60-62 Wall St. and 63-65 Pine St.
New York

Clinton & Russell,
Architects

THE METROPOLITAN FIREPROOFING COMPANY'S SYSTEM of fireproofing has been employed in many of the largest and most prominent buildings throughout the country for the past twenty years. In taking over this system from the METROPOLITAN FIREPROOFING COMPANY, the Keystone Fireproofing Company has secured the services of the bulk of the organization of the former Company, thus insuring against any deviation from the successful methods that have always been a strong characteristic of the METROPOLITAN SYSTEM in the past.

In New York City alone there are more than thirty buildings ranging from 100 feet to 340 feet in height, constructed under this system, in addition to the scores of smaller buildings in which it has been installed.

Actual fires and conflagrations have demonstrated repeatedly that a material may be sufficiently fire-resisting to withstand any temperature to which it might be subjected in a burning building, and yet be entirely unsuitable as a fireproofing material. Paradoxically speaking, a system of fireproofing that is merely "fireproof" will not answer. To be effective it must not only be in itself *fire-resisting*, but must be sufficiently *non-conducting* to prevent the beams and girders that it is designed to protect from becoming heated to an injurious degree.

It has been proven that a temperature of 800 degrees F. weakens steel 10 per cent., and that a temperature of 1700 degrees F. causes it to lose 50 per cent. of its efficiency. This being so, it is obvious that there is no factor of greater importance in the selection of a fireproofing system than this feature of non-conductivity as distinguished from mere fire-resistance.

It is the purpose of this booklet to present briefly the reasons why the METROPOLITAN FIREPROOFING COMPANY'S SYSTEM is superior to any other system of fireproofing, not merely in respect to non-conductivity, but in all of the other features essential in modern building construction.

In doing this comparisons are made with other systems of fireproofing; but let it be understood that these comparisons are confined strictly to questions of fact, in no way intended to disparage other admittedly good forms of construction, but to accomplish the legitimate purpose of proving wherein the METROPOLITAN FIREPROOFING COMPANY'S SYSTEM is superior to others.

The Metropolitan Fireproofing Company's System

THE principle of the METROPOLITAN FIREPROOFING COMPANY'S SYSTEM is the reinforcement of a floor or roof plate by wire cables from 1 inch to 3 inches apart, brought to a *deflection* and into *tension* between each pair of beams or purlins.

The plate itself consists of METROPOLITAN composition, composed principally of pure calcined gypsum. This composition solidifies in from 20 to 30 minutes after being poured in place, and the wood centering can then be safely removed. The resulting floor is then sufficiently strong to be used at once, and *within an hour* after it is poured *provides a working floor* that can be safely used under the loads for which it has been calculated.

The upper surface, being uniform and level above the tops of the beams, is then ready for the laying of the wood sleepers or concrete, and as soon as the blocks are set in place along the webs and flanges of the girders, the furring and metal lathing is put in place underneath and the ceilings are ready for plastering.

CORCORAN ART GALLERY
WASHINGTON, D. C.

Ernest Flagg,
Architect

Strength

IT can be stated without qualification that the METROPOLITAN FIREPROOFING COMPANY'S SYSTEM is the *strongest* and *safest* system of floor construction upon the market.

In any form of reinforced concrete floor construction, the ultimate strength of the arch is determined by calculating the strength of the concrete in compression, and of the reinforcement in tension. An intentional or accidental deterioration in the quality of the concrete, or a failure of any part of the mass to establish a bond with the reinforcement, destroys absolutely the value of such calculations.

A floor constructed of hollow tile depends for its strength solely upon the arch principle. The failure of a mason to properly key it, or the presence in an arch of a broken or imperfect tile, as is bound to happen in the handling of large quantities of any hard, brittle material, destroys completely the principle of the construction, causing it to become in effect nothing more than a permanent centering for the concrete filling on top, upon which the actual strength of the floor is then dependent.

In the METROPOLITAN FIREPROOFING COMPANY'S SYSTEM none of these elements of uncertainty are present. Notwithstanding the fact that the composition out of which the floor plate is cast has a *crushing strength* of more than *14,000 pounds per square foot, this is entirely disregarded* in calculating the strength of the arch.

Being supported by continuous wire cables, securely fastened at each end and brought into *deflection* and *tension*, the stresses are calculated by ordinary engineering formulæ, and it is these *cables* that are relied upon *exclusively* to carry the load, and *not the combination* of the metal and the floor filling as in other systems. In other words, being strictly a metal system, its strength can be calculated with the same accuracy as that of a suspension bridge, and for this reason it is the *only system* of fireproof floor construction that has ever been permitted by the New York Bureau of Buildings to be designed with a factor of safety of four, as in metal work, instead of a factor of safety of ten, as required in all forms of concrete and masonry construction.

HECKER-JONES-JEWELL FLOUR MILLS
Coenties Slip and East River
NEW YORK

J. B. Snook & Sons,
Architects

In the twenty years during which this system has been in use, *not a single arch has ever fallen* from any cause whatsoever.

The remarkable strength of this construction can be appreciated by the results of the innumerable load tests that have been made from time to time, records of which are contained in Part II of this book.

Mutual Building
9th and Main Streets
Richmond, Va.

Clinton & Russell,
Architects

Fire Resistance and Non-conductivity

THE composition used in the METROPOLITAN FIREPROOFING COMPANY'S SYSTEM consists principally of pure calcined gypsum, together with a percentage of wood chips. While gypsum is to-day generally recognized as the most effective material for fire-protection that is known commercially, the rock from which this composition is made is mined from our own deposits, and calcined by a special process that develops in it the highest degree of fire-resistance that can be obtained in any material used for this purpose.

The presence of the wood chips in this composition gives to it a degree of toughness and elasticity that is not to be found in any other fireproofing material, and being present in but a small proportion, they are completely insulated by the greater mass of gypsum in which they are imbedded, in no way detracting from the fire-resistance of the composition.

While clay tile and stone concrete are both fireproof in the sense of being incombustible, neither of these materials develop a high efficiency as non-conductors, and in offering resistance to the transmission of heat to the beams and girders that they are intended to protect; moreover, when they have become heated to a high degree of temperature, the sudden application of a stream of water will cause them to crack and fly. Both of these materials also possess a comparatively high coefficient of expansion. In nearly all severe fires it has been observed that expansion has fractured the webs of hollow tile, causing the lower shells to fall.

Cinder concrete, while not possessing the strength of stone concrete, is superior to it as well as hollow tile both in non-conductivity and in having a lower coefficient of expansion, but it is still greatly inferior in both respects to gypsum.

METROPOLITAN composition, on the other hand, has a *coefficient of expansion of practically zero*, and is so remarkable a non-conductor of heat that a moderate thickness prevents the passage of nearly all warmth. In the most severe fire tests, the *beams have remained cold*, and, consequently, unaffected, while in some cases beams protected by hollow tile and other materials have been so affected by heat as to deflect and allow the floor arches to fall before the flames had injured them.

When exposed to fire for four or five hours, the METROPOLITAN

Forty-two Broadway Building
36-42 Broadway
New York

Henry Ives Cobb,
Architect

composition is attacked to a depth of from 3-16 inch to 1 inch, the remainder being unaffected, and neither cracking, flying nor showing any trace of disintegration when a stream of water is applied.

During prolonged tests floor plates of this material have remained *perfectly cool* on the surface not exposed to the flame. Witnesses of tests have stood on floors made of this material with fires under them equal in effect to a conflagration; and, in the case of one test, which is a matter of record in the New York Bureau of Buildings, *snow remained unmelted* on the upper surface while the underside was exposed to a *continuous fire for four and one-half hours.*

In the official test for the New York Bureau of Buildings on May 20, 1897, *sufficient heat did not reach the beams to affect the paint.*

With no other system has such complete protection been afforded. We openly challenge any other system of fireproofing upon the market to a comparative fire and water test, to be conducted according to the test specifications of the New York Bureau of buildings under the direction of the Engineering Department of Columbia University, New York, Massachusetts Institute of Technology, Boston, or the Underwriters' Laboratories, Chicago.

All of the foregoing facts are substantiated by the various fire and water tests to which the METROPOLITAN FIREPROOFING COMPANY'S SYSTEM has been subjected, the detailed official records of which are contained in Part II of this book.

Republican Club
54-56 West 40th Street
New York

York & Sawyer,
Architects

Lightness and Economy

THE METROPOLITAN FIREPROOFING COMPANY'S SYSTEM is by far the *lightest* floor construction upon the market, the arch itself for ordinary hotel, apartment house or office building loads weighing but 14 pounds per square foot.

In most localities the cost of METROPOLITAN floors in place, left level above the tops of the beams, and with metal lathing and furring in place ready for plastering underneath, compares favorably with any first-class flat-ceiling cinder-concrete construction, and is substantially cheaper than stone concrete or hollow tile arches. But when the extreme lightness in weight of the METROPOLITAN FIREPROOFING COMPANY'S SYSTEM is considered in designing the steel work and the foundations, and the consequent saving in metal computed, it is found that the use of this construction will prove *more economical than any other system* that can be employed.

Our Engineering Department will promptly prepare for an architect or owner a complete steel layout and column schedule for any type of building, charging only actual cost for this service, *which will be refunded in full* if we are awarded the contract for fireproofing.

Table of Dead Load

Metropolitan Fireproofing Company's System

Weight of floor plate	14	lbs.	per	sq.	ft.
" " beam filling, averaged	3	"	"	"	"
" " plastering applied directly to under side of arch	4	"	"	"	"
" " 2" x 3" sleepers and cinder fill	10	"	"	"	"
" " 7/8" wood floor	4	"	"	"	"
Total dead load	35	"	"	"	"

NOTE: If Form A, with furring and metal lathing for flat ceilings underneath, add 4 lbs. per sq. ft. to above. If cement floor is to be used instead of wood, add 6 lbs. per sq. ft. to above.

The foregoing weights will apply to practically all types of buildings, except for the very heaviest types of factories or warehouses.

City Hall
Savannah, Ga.

H. W. Witcover,
Architect

Sound-deadening

THERE is no type of building where the prevention of the communication of sound from floor to floor is not desirable, and this feature assumes the highest importance in hotels, apartment houses, residences, educational institutions and buildings devoted to musical purposes.

KEYSTONE GYPSUM BLOCK PARTITIONS have been proven in practice and by actual comparative tests to be the most nearly perfect non-conductors of sound of any material on the market. Hence, METROPOLITAN FIREPROOFING COMPANY'S FLOORS, made from the same material, possess exactly the same degree of efficiency in this respect, emphasized still more by the greater thickness of the floor plate as compared with the partition blocks.

In any manufacturing building where this system of floor construction has been installed, one can enter, and the noise of heavy-running machinery upon the floor above will be *entirely inaudible* if the stair and elevator openings leading above are properly closed.

Langham Apartments
73d, 74th Streets and Central Park West
New York

Clinton & Russell,
Architects

Rapidity of Construction

THERE is no more important factor in determining the probable time required to complete a modern building operation than the speed with which the floor arches can be installed. After the erection of the steel has begun for a skeleton frame structure, the progress of the balance of the work depends absolutely upon the fireproofing. Every day that can be saved in completing the floor and roof arches represents a gain of a day in the time required to turn over the completed building.

When it is considered that the carrying charges on a building operation often amount to hundreds of dollars daily, the total of which must be added to the cost, it will be apparent that the selection of the system of fireproofing may often prove to have been a strong influence in the investment value of the completed building.

There is not, nor never has been, a system of fireproofing that could be installed as rapidly as the METROPOLITAN FIREPROOFING COMPANY'S SYSTEM. Reaching, as it does, its initial set within not over thirty minutes from the time it is poured, the centers can be dropped in an hour's time and moved up to the floor above, leaving the lower floor *absolutely clear,* ready for the ceilings,, partitions and plastering.

Compare this result with other systems such as concrete, where the centers must be left in place at least two weeks, resulting in six or eight floors sometimes remaining centered at once, during which time no other work can be done upon them.

Furthermore, with the METROPOLITAN FIREFROOFING COMPANY'S SYSTEM, the season of the year does not enter into an estimate of the time required to complete a building. With hollow tile or concrete floors a temperature below 32 degrees means a day lost, but as the composition used in the METROPOLITAN FIREFROOFING COMPANY'S SYSTEM sets before it has had time to freeze, this construction can be installed in any weather when men can work, irrespective of temperature.

The job diaries of the contractors who erected the buildings illustrated herein are proof of the unequaled speed with which fireproof floors may be installed if the METROPOLITAN FIREPROOFING COMPANY'S SYSTEM is used.

Garvin Machine Co. Building
Varick and Spring Streets
New York

C. C. Haight,
Architect

Preservation of Metal Work

CONTRARY to an old popular belief, there is no material that can be used for fireproofing purposes that excels gypsum as a preventive of corrosion. In the process of calcination to which the raw gypsum is subjected by us for the manufacture of METROPOLITAN composition and KEYSTONE GYPSUM BLOCKS, all of the free acids and gases escape. When it is poured into place around the beams and the wire cables, crystallization immediately begins, and in from fifteen to thirty minutes the metal is hermetically sealed within.

Innumerable small sections of METROPOLITAN arches have been removed from time to time, from buildings eight or ten years old, and in every case the cable wires embedded therein have been *as bright as when installed*, after removing with the fingers the thin film of initial rust that invariably forms when any wet substance touches metal.

HENRY W. POOR RESIDENCE
TUXEDO PARK, N. Y.

T. H. Randall,
Architect

Roof Construction
For
Manufacturing Plants

THE METROPOLITAN FIREPROOFING COMPANY'S SYSTEM of roof construction for main roofs, monitors, lean-to's, etc., of one-story manufacturing buildings has proven superior to any other form of construction for many reasons:

1st—It is the lightest type of fireproof roof, weighing not over 12 pounds per square foot in place ready for the finished roofing material. This permits of a substantial saving in the weights of trusses and purlins, an economy that more than offsets any slight difference in the first cost of the METROPOLITAN FIREPROOFING COMPANY'S SYSTEM as compared with others. We have frequently installed this construction upon steel designed to carry only wood roofs, with thoroughly satisfactory results and without overloading.

2d—It leaves a level, even surface on top, to which slag or other forms of roofing may be directly applied.

3d—It will hold nails almost as well as wood.

4th—It leaves a smooth, even surface underneath, requiring only a coat of cold water paint, and the whiteness of which adds greatly to the light in the building both day and night.

5th—It can be installed more rapidly than any other form of construction, and in any weather when men can work, irrespective of freezing temperatures.

6th—Its elasticity insures against cracks developing from the vibration caused by cranes and other heavy machinery.

7th—Its non-conductivity of heat and cold results in a cooler building in summer, and in winter *reduces operating expenses* by effecting a substantial economy in the cost of heating. We can refer you direct to manufacturing concerns, whose buildings are constructed with the METROPOLITAN roof construction, and who will give you the accurate cost figures of heating these buildings as compared with other buildings of equal size in their own plant having other forms of roofs. In some cases the saving in heating alone of a single building has run as high as $1200 or $1500 per annum.

Atlantic Building
William and Wall Sts., and Exchange Place
New York

Clinton & Russell
Architects

Quality Insurance

ONE of the many reasons for the strong preference felt for the METROPOLITAN FIREPROOFING COMPANY'S SYSTEM by architects who specify and use it in their most important work, is the sense of security which its use affords them.

In a hollow tile floor arch the value of the construction depends entirely upon the use of perfect tile, and careful workmanship in setting and keying.

With concrete, the best of cement, sand, stone or cinders means nothing unless they are used in the proper proportions. As it is obviously impracticable for the architect's superintendent to personally watch every mixing, his only security is his faith in the contractor; but if, as often happens, the contractor's foreman is influenced by a false idea of economy in saving cement, what then? Neither the architect nor the contractor can detect it until the damage has been done.

Every cement manufacturer and every concrete contractor will tell you that concrete, made of good cement and the proper aggregate, and with reinforcement correctly designed for the conditions to be met, cannot fail. Although we are competitors of concrete, we frankly admit this, and yet every week, every day almost, we read of concrete arches failing that are constructed with proper reinforcement, and *specified* to be of the proper aggregate. There is but one answer—the human element.

Practically speaking, the METROPOLITAN FIREPROOFING COMPANY'S SYSTEM is "fool-proof" and "thief-proof," for the man who signs a contract to furnish concrete of a certain aggregate, and deliberately weakens it to increase his profit, is entitled to no milder name. When we sign our contract for the fireproofing of a building, we furnish the architect with a blue-print, showing a section of the arch, the spacing of the cables, their deflection, etc. A glance at the building once a day is all that is necessary to enable him to see that he is getting what his client is paying for in this respect.

This leaves only the composition to be examined. Manufactured at our mills, by the thousands of tons, each ingredient automatically measured, mechanically mixed, bagged and shipped to the four points of the compass, its uniformity is necessarily obvious. Arriving at the building, the bag is opened and *nothing is added but*

New York Public Library
190-192 Amsterdam Ave.
New York

Carrere & Hastings,
Architects

water. A sample from any bag and a small sieve enables the architect, in his office, to prove in five minutes that he is getting the proper proportions, as the formula will be furnished him by us in confidence upon request. A dish of any sort and a glass of water permits him to complete the test and prove its set.

It is beyond the power of any one to adulterate METROPOLITAN composition and "get away with it." Any attempt to inject foreign materials, or change the proportions of the contents of a single bag, would so affect the set as to be obvious to the most casual observer within twenty minutes.

The award of a contract for fireproofing to this Company, therefore, is in effect the delivery to the architect of a policy *insuring the quality of the work*.

Bancroft Building
5 West 29th Street
New York

R. H. Robertson
Architect

In General

WE permit no one to install the METROPOLITAN FIREPROOFING COMPANY'S SYSTEM of floor and roof construction but ourselves; and whenever practicable, prefer to bid upon KEYSTONE GYPSUM BLOCKS for the partitions, column protection, wall furring, etc., erected in place ready for plastering. NO KEYSTONE BLOCK or METROPOLITAN floor *has ever failed*, either in a test or an actual fire, and the relation of the floors, partitions and column protection to one another under fire is so close that the use of *all* in any building is of importance to the architect and owner as well as ourselves.

Booklets descriptive of KEYSTONE BLOCKS and the tests and fires through which they have passed, will be gladly mailed gratis upon request.

Plans sent to any of our sales offices, at our expense, will be promptly returned with a bona fide bid, together with such suggestions as to the specifications as our wide experience in the fireproofing field may enable us to offer with a view to increasing efficiency or decreasing cost.

Fifteen years' experience in the construction as well as the manufacture of fireproofing, has enabled us to build up a field organization that has no equal in this country, and the employment of which not only insures to the architect the highest standard of workmanship and a maximum speed, but a hearty co-operation in meeting promptly and successfully the many small problems and details that arise on every building, and which cannot be foreseen.

The capacity of our various factories is the largest of their kind in the world, insuring promptness in making shipments.

In addition to the careful supervision given to the selection of the gypsum rock before it leaves our mines, the material itself is carefully inspected at each process of manufacture. It is this rigid inspection that preserves the well-known uniformity of quality that has always been characteristic of KEYSTONE products.

Babies' Hospital
55th St. and Lexington Ave.
New York

York & Sawyer,
Architects

SPECIFICATION FOR

Metropolitan Fireproofing Company's System Fireproof Floor Construction

FORM "A"

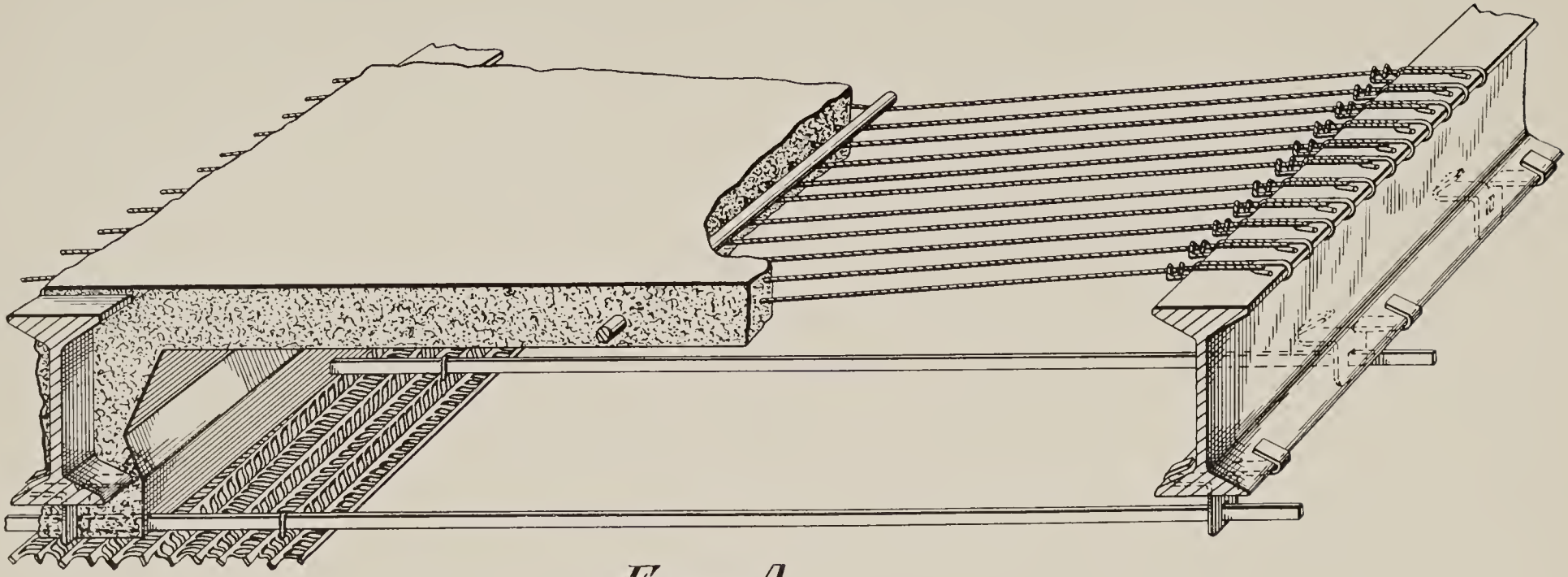
METAL clips shall be fastened to the bottom flanges of the floor beams, which shall support 1″ x 3-16″ flat iron bars spaced 16″ on centers running transversely with the floor beams, tops of such flats to be on a level about 1½″ below the bottom flanges.

To take the plaster there shall be fastened to the 1″ flats approved metal lathing coated with asphaltum.

By means of forms or centers placed about the bottom flanges of the floor beams and girders a 1½″ covering of METROPOLITAN composition shall be cast in place protecting the bottom flanges of the floor beams and girders.

Cables, each composed of two No. 12 galvanized wires, twisted, shall be carried over the tops of the floor beams and shall be secured to walls by anchors and bars; or where they end on a beam, shall be secured to it by strong hooks. These cables shall be laid parallel and pass under round iron bars, midway between the beams, so as to cause the cables to deflect uniformly. The cables shall be laid at distances apart from each other, varying from 1″ to 3″ according to the spans.

Forms or centers shall be put in place between the floor beams 1″ below the round iron bars mentioned above. The composition mentioned above shall be poured in place and brought to a level ½″ above the tops of the flanges of the floor beams, and form a floor plate about 4″ thick, ready for the laying of wood sleepers or concrete on top.



Form A.

SPECIFICATION FOR

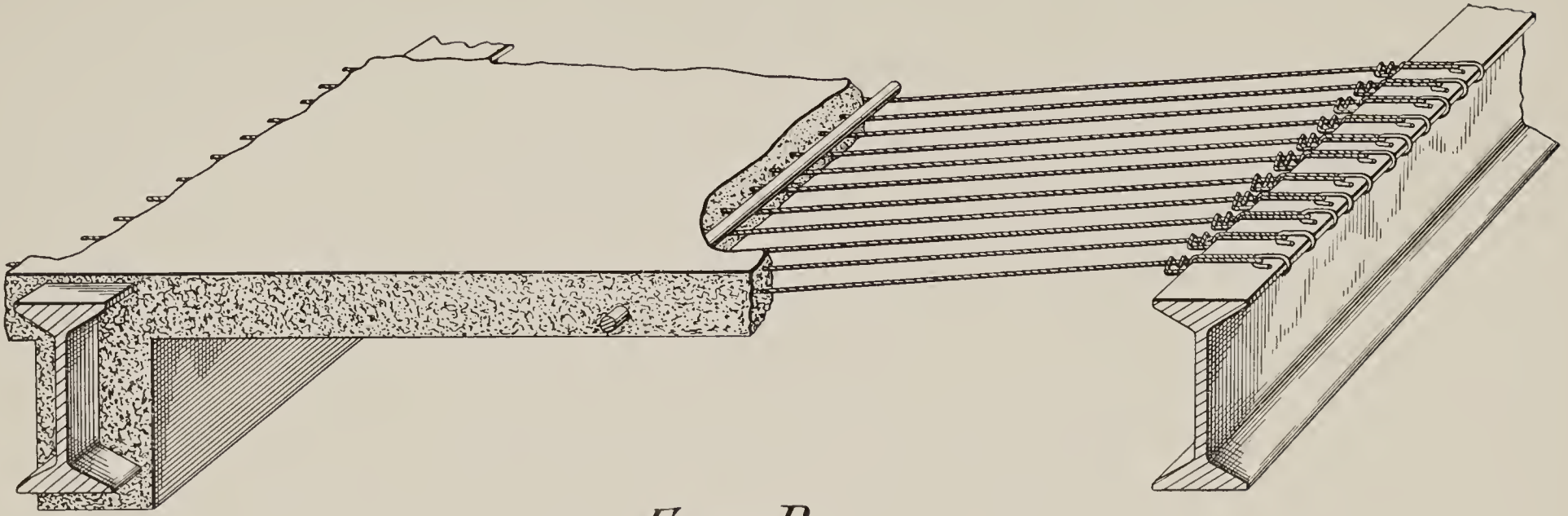
Metropolitan Fireproofing Company's System Fireproof Floor Construction

FORM "B"

BY means of forms or centers placed about the bottom flanges of the floor beams and girders, a 1½" covering of METROPOLITAN composition shall be cast in place, protecting the bottom flanges of the floor beams and girders.

Cables, each composed of two No. 12 galvanized wires, twisted, shall be carried over the tops of the floor beams and shall be secured to walls by anchors and bars; or where they end on a beam, shall be secured to it by strong hooks. These cables shall be laid parallel and pass under round iron bars, midway between the beams, so as to cause the cables to deflect uniformly. The cables shall be laid at distances apart from each other, varying from 1" to 3" according to spans.

Forms or centers shall be put in place between the floor beams 1" below the round iron bars mentioned above. The composition mentioned above shall be poured in place and brought to a level ½" above the tops of the flanges of the floor beams and form a floor plate about 4" thick, ready for the laying of wood sleepers or concrete on top, and the plastering or painting underneath.



Form B.

Buildings in New York City over 100 Feet High

constructed under

METROPOLITAN FIREPROOFING COMPANY'S SYSTEM

BUILDING	STORIES	FEET HIGH
Sixty Wall Street, Building,	28	340
Forty-two Broadway, Building,	21	240
Hudson Building, 32-34 Broadway,	16	221
Atlantic Mutual Building, 49 Wall Street,	18	260
Beaver Building, Beaver and Pearl Streets,	16	200
Singer Building, Broadway and Prince Street,	12	170
Woodbridge Building, William and John Streets,	13	170
Samson Building, 63-65 Wall Street,	12	161
Bancroft Building, 5-7 West 29th Street,	10	143
Standish Arms Hotel, Brooklyn,	12	140
51 East 18th Street,	10	130
13th Street and Broadway,	13	124
Fahy's Building, 54 Maiden Lane,	12	120
Hartford Building, 17th Street and Union Square,	11	120
Loft Building, 37-39 East 21st Street,	10	120
Daniell's Department Store, Broadway and 8th Street,	8	108
Republican Club, 54-56 West 40th Street,	12	100
Garvin Machine Company Building, Varick and Spring Streets,	8	100
Graham Building, Church and Duane Streets,	12	100
Bishop Building, William and Liberty Streets,	12	100
Broadway Tabernacle, 56th Street and Broadway,	7	100
Hotel Stratford, 11-13 East 32d Street,	13	100
Astor Apartments, 75th Street and Broadway,	8	100
180 Broadway, Building,	12	100
55 West 21st Street,	9	100
Loft Building, 27 East 21st Street,	10	100

NAVAL Y. M. C. A. BUILDING
Sands and Charles Streets
BROOKLYN-NEW YORK

Parish & Schroeder
Architects

Partial List of Buildings Constructed Under
METROPOLITAN FIREPROOFING COMPANY'S SYSTEM

BUILDING	ARCHITECT	QUANTITY OF WORK
Forty-two Broadway, Building, 36-42 Broadway, New York.	Henry Ives Cobb, New York.	370,000 sq. ft.
Broadway Tabernacle, 50th Street and Broadway, New York.	Barney & Chapman, New York.	54,000 sq. ft.
Hotel Stratford, 11-13 East 32d Street, New York.	Neville & Bagge, New York.	45,000 sq. ft.
Ivy Courts Apartment House, 210 West 107th Street, New York.	W. C. Hazlett, New York.	12,000 sq. ft.
Peoples' Bank Building, South Orange, N. J.	Robert S. Stephenson, New York.	3,300 sq. ft.
William G. Park Residence, Westbury, L. I.	S. E. Gage, New York.	4,000 sq. ft.
Home Insurance Company Building, 52-56 Cedar Street, New York.	Clinton & Russell, New York.	30,000 sq. ft.
Bergen & Lafayette Trust Company Building, Jersey City, N. J.	Clinton & Russell, New York.	4,800 sq. ft.
New York Eye and Ear Infirmary, 13th Street and 2d Avenue, New York.	R. W. Gibson, New York.	11,200 sq. ft.
Fairfield Memorial Library Building, Fairfield, Conn.	C. T. Beardsley, Jr., Bridgeport, Conn.	6,100 sq. ft.
Jones & Morgan Block, Waterbury, Conn.	Joseph A. Jackson, New York.	40,500 sq. ft.
John Murray Mitchell Residence, Tuxedo Park, N. Y.	Clinton & Russell, New York.	12,000 sq. ft.
New Haven Savings Bank Building, New Haven, Conn.	Brite & Bacon, New York.	5,000 sq. ft.

Pennsylvania Railroad Terminal
Jersey City, N. J.

Pennsylvania Railroad Company
Architects

BUILDING	ARCHITECT	QUANTITY OF WORK
Sixty Wall Street, Building. 60-62 Wall Street, 63-65 Pine Street, New York.	Clinton & Russell, New York.	204,000 sq. ft.
Carnegie Library, No. 9, 112-114 East 96th Street, New York.	Babb, Cook & Williard, New York.	13,500 sq. ft.
Mutual Assurance Society Building, Richmond, Va.	Clinton & Russell, New York.	125,000 sq. ft.
Richmond County Jail, Staten Island, New York.	W. H. Mersereau, New York.	4,200 sq. ft.
City Hall, Savannah, Ga.	H. W. Witcover, Savannah, Ga.	33,000 sq. ft.
Lew Fields Theatre, 42d Street and 8th Avenue, New York.	———	8,700 sq. ft.
Weber & Fields Theatre, Broadway and 29th Street, New York.	Thomas W. Lamb, New York.	2,000 sq. ft.
Alexander Residence, No. 4-8 West 58th Street, New York.	Warren & Wetmore, New York.	13,000 sq. ft.
Pennsylvania Railroad Power House, Trenton, N. J.	Pennsylvania Railroad Company, Philadelphia, Pa.	8,400 sq. ft.
New York Edison Building, Pearl and Elm Streets, New York.	New York Edison Co., New York.	2,000 sq. ft.
Ehrich Building, 22d Street and 6th Avenue, New York.	Buchman & Deisler, New York.	34,000 sq. ft.
St. Luke's Hospital, Cathedral Heights, New York.	Ernest Flagg, New York.	
Little Sisters of the Poor Building, New York.	Jardine, Kent & Jardine, New York.	17,000 sq. ft.
Carrera Building, Havana, Cuba.	Purdy & Henderson, New York.	11,200 sq. ft.
Schinasi Brothers Factory, 309-311 West 120th Street, New York.	Gillespie & Carrell, New York.	18,000 sq. ft.
The Ingersoll-Sergeant Drill Co.'s Plant, Phillipsburg, N. J.	Wm. Prellwitz, Chief Engineer, Easton, Pa.	177,000 sq. ft.

Beaver Building
Beaver, Pearl, and Wall Streets
New York

Clinton & Russell
Architects

BUILDING	ARCHITECT	QUANTITY OF WORK
Arnold Building, Paterson, N. J.	Charles Edwards, Paterson, N. J.	12,000 sq. ft.
Holy Trinity School, 212 West 83d Street, New York.	J. H. McGuire, New York.	6,400 sq. ft.
Physical Laboratory, Teachers' College, 120th Street and Amsterdam Avenue, New York.	Parish & Schroeder, New York.	50,000 sq. ft.
Bishop Building and Additions, William and Liberty Streets, New York.	Clinton & Russell, New York.	104,000 sq. ft.
Carnegie Library, No. 4, 140th Street and Alexander Avenue, New York.	Babb, Cook & Willard, New York.	15,000 sq. ft.
New York Public Bath House, 243-247 East 109th Street, New York.	York & Sawyer, New York.	12,000 sq. ft.
New York Public Bath House, 347-349 West 41st Street, New York.	York & Sawyer, New York.	9,600 sq. ft.
New York Public Bath House, 133-135½ Allen Street, New York.	York & Sawyer, New York.	8,000 sq. ft.
Singer Building, Broadway and Prince Street, New York.	Ernest Flagg, New York.	98,000 sq. ft.
Loft Building, 27 East 21st Street, New York.	G. A. Schellinger, New York.	17,000 sq. ft.
Loft Building, 38 East 21st Street, New York.	W. G. Pigueron, New York.	16,000 sq. ft.
Standish Arms Hotel, 169 Columbia Heights, Brooklyn, N. Y.	Goldwin Starrett, New York.	66,000 sq. ft.
Woodhull Building, 35-37 West 31st Street, New York.	Augustus N. Allen, New York.	30,000 sq. ft.
Dochterman Building, 469-471 East 10th Street, New York.	L. C. Holden, New York.	3,100 sq. ft.
Van Norden Trust Company Building, 5th Avenue and 60th Street, New York.	H. J. Hardenburg, New York.	6,900 sq. ft.
Atlantic Building and Additions, William and Wall Sts. and Exchange Pl., New York.	Clinton & Russell, New York.	181,000 sq. ft.

Physical Educational Building, Teachers' College
120th Street and Amsterdam Avenue
New York

Parish & Schroeder
Architects

BUILDING	ARCHITECT	QUANTITY OF WORK
Arthur Scribner Residence, 39 East 67th Street, New York.	Ernest Flagg, New York.	
Williamsburg Trust Company Building, 391-393 Fulton Street, Brooklyn, N. Y.	Helmle, Huberty & Hudswell, Brooklyn, N. Y.	17,000 sq. ft.
Frederick Loeser & Company Building, Livingston Street and Elm Place, Brooklyn, N. Y.	Francis H. Kimball, New York.	28,000 sq. ft.
Beaver Building, Beaver, Pearl and Wall Streets, New York.	Clinton & Russell, New York.	101,000 sq. ft.
Cornwall & Patterson Mfg. Co. Building, Bridgeport, Conn.		
Carnegie Library, No. 8, 190-192 Amsterdam Avenue, New York.	Carrere & Hastings, New York.	14,000 sq. ft.
Loft Building, 37-39 East 21st Street, New York.	John W. Stevens, New York.	42,000 sq. ft.
Richard P. Lounsberry Residence, 14 East 52d Street, New York.	Clinton & Russell, New York.	15,000 sq. ft.
Naval Branch, Y. M. C. A., Sands and Charles Streets, Brooklyn, N. Y.	Parish & Schroeder, New York.	50,000 sq. ft.
Astor Apartment House, 75th Street and Broadway, New York.	Clinton & Russell, New York.	128,000 sq. ft.
John Daniell, Sons and Sons' Store, Broadway and 8th Street, New York.	Clinton & Russell, New York.	37,000 sq. ft.
Congregate Dining Hall Building, Conn. Hospital for Insane, Middletown, Conn.	Curtis & Johnson, Hartford, Conn.	72,000 sq. ft.
William E. Iselin Residence, 745 5th Avenue, New York.	Clinton & Russell, New York.	4,000 sq. ft.
T. Farley's Sons' Residence, 5th Avenue, near 80th Street, New York.	Turner & Kilian, New York.	10,000 sq. ft.
Turner Library Building, Torrington, Conn.	Stephenson & Greene, New York.	3,000 sq. ft.
Hartford Electric Light Company Building, Hartford, Conn.		

BUILDING	ARCHITECT	QUANTITY OF WORK
Archibald D. Russell Residence, Princeton, N. J.	Clinton & Russell, New York.	28,000 sq. ft.
F. Norton Goddard Residence, 273 Lexington Avenue, New York.	G. E. Wood, New York.	
Hotel Bolkenhayn, 58th Street and 5th Avenue, New York.	Alfred Zucker, New York.	3,100 sq. ft.
Bigelow Building, 106 6th Avenue, New York.	John E. Nitchie, New York.	20,500 sq. ft.
Platt Block, Waterbury, Conn.	Curtis & Johnson, Hartford, Conn.	27,000 sq. ft.
Republican Club Building, 54-56 West 40th Street, New York.	York & Sawyer, New York.	43,000 sq. ft.
Victoria Theatre, 42d Street and Broadway, New York.	———	8,000 sq. ft.
Apartment Hotel, 98th Street near West End Avenue, New York.	H. Alban Reeves, New York.	54,000 sq. ft.
Loft Building, 22 East 21st Street, New York.	F. C. Zobel, New York.	14,000 sq. ft.
Quackenbush Department Store, Paterson, N. J.	Charles Edwards, Paterson, N. J.	94,000 sq. ft.
Ivy Courts Apartment House, 230 West 107th Street, New York.	Wm. C. Hazlett, New York.	10,000 sq. ft.
Speyer School, 94 Lawrence Street, New York.	E. A. Josselyn, New York.	16,000 sq. ft.
Eugene S. Reynal Residence, White Plains, N. Y.	Donn Barber, New York.	30,000 sq. ft.
Carnegie Library, No. 1, 222 East 79th Street, New York.	James Brown Lord, New York.	12,000 sq. ft.
Loft Building, 16 East 18th Street, New York.	Buchman & Fox, New York.	16,000 sq. ft.
Babies' Hospital, 55th Street and Lexington Avenue, New York.	York & Sawyer, New York.	21,000 sq. ft.

BUILDING	ARCHITECT	QUANTITY OF WORK
St. Charles Barromeo Church, 141st Street near 7th Avenue, New York.	George H. Streeton, New York.	12,000 sq. ft.
Apartment House, 63d Street and Madison Avenue, New York.	Buchman & Fox, New York.	12,000 sq. ft.
Rogers, Peet & Company Building, 13th Street and Broadway, New York.	Clinton & Russell, New York.	8,500 sq. ft.
Peter F. Meyer Stable, Mamaroneck, N. Y.	Horgan & Slattery, New York.	4,000 sq. ft.
Y. M. C. A. Building, Newark, N. J.	Charles Alling Gifford, New York.	15,000 sq. ft.
Loft Building, 180 Broadway, New York.	Clinton & Russell, New York.	25,000 sq ft.
Henry A. Babcock Residence, 22 East 52d Street, New York.	Clinton & Russell, New York.	8,500 sq. ft.
Southern New England Telephone Building, Bridgeport, Conn.	L. W. Robinson, New Haven, Conn.	14,000 sq. ft.
Loft Building, 35 West 21st Street, New York.	Frederick Zobel, New York.	17,000 sq. ft.
South Hospital, Conn. Hospital for the Insane, Middletown, Conn.	Curtis & Johnson, Hartford, Conn.	5,000 sq. ft.
Clinical Building, Yale University, New Haven, Conn.	L. W. Robinson, New Haven, Conn.	21,000 sq. ft.
H. W. Poor Residence, Tuxedo Park, N. Y.	T. H. Randall, New York.	19,000 sq. ft.
H. W. Poor Stables, Tuxedo Park, N. Y.	T. H. Randall, New York.	3,000 sq. ft.
M. T. Pyne Residence, Princeton, N. J.	Clinton & Russell, New York.	21,000 sq. ft.
Washington Building, New Haven, Conn.	L. W. Robinson, New Haven, Conn.	22,000 sq. ft.

BUILDING	ARCHITECT	QUANTITY OF WORK
Hammond Typewriter Company Factory, 69th Street and East River, New York.	L. C. Holden, New York.	48,000 sq. ft.
Broad Street Station, Pennsylvania Railroad Co., Philadelphia, Pa.		
Christ Hospital, Jersey City, N. J.	L. C. Holden, New York.	
Model Tenements, 64th Street and 1st Avenue, New York.	James E. Ware, New York.	17,000 sq. ft.
Mulligan Warehouse, Newark, N. J.	————	14,000 sq. ft.
Warehouse, 150 5th Avenue, New York.	E. H. Kendall, New York.	14,000 sq. ft.
Pennsylvania Railroad Station, Jersey City, N. J.	Pennsylvania Railroad Company.	23,000 sq. ft.
Apartment House, 135th Street and 5th Avenue, New York.	Stein, Cohen & Roth, New York.	6,000 sq. ft.
O'Reilly Brothers Warehouse, 123d Street and St. Nicholas Avenue, New York.	O'Reilly Brothers, New York.	8,000 sq. ft.
Manhattan Bank Building, Broadway and Bleecker Street, New York.	Kimball & Thompson, New York.	6,000 sq. ft.
St. Nicholas Skating Rink, 69 West 66th Street, New York.	Ernest Flagg, New York.	46,000 sq. ft.
Apartment House, 107th Street and Amsterdam Avenue, New York.	Angell & Higginson, New York.	4,000 sq. ft.
Clifton Springs Sanitarium, Clifton Springs, N. Y.	Pierce & Bickford, Elmira, N. Y.	49,000 sq. ft.
Burlington Arcade, Stamford, Conn.	Quimby & Broome, New York.	38,000 sq. ft.
Samson Building, 63-65 Wall Street, New York.	Clinton & Russell, New York.	47,000 sq. ft.

BUILDING	ARCHITECT	QUANTITY OF WORK
Olympia Theatre, Broadway, 44th and 45th Streets, New York.	J. B. McElfatric & Son, New York.	33,000 sq. ft.
Helmke Apartment House, New York.	E. L. Angell, New York.	16,000 sq. ft.
Baker Building, Philadelphia, Pa.	Frank Miles Day, Philadelphia, Pa.	20,000 sq. ft.
Garvin Machine Company Building, Varick and Spring Streets, New York.	C. C. Haight, New York.	85,000 sq. ft.
Phelps Memorial Building, New Haven, Conn.	C. C. Haight, New York.	17,000 sq. ft.
Red Lion Inn, Stockbridge, Mass.	H. Neil Wilson, Pittsfield, Mass.	
Roslindale School, Boston, Mass.	Walker & Kimball, Boston, Mass.	
St. Bartholomew's Parish House, 42d Street and 3d Avenue, New York.	Clinton & Russell, New York.	29,000 sq. ft.
Bancroft Building, 5 West 29th Street, New York.	R. H. Robertson, New York.	46,000 sq. ft.
Graham Building, Church and Duane Streets, New York.	Clinton & Russell, New York.	30,000 sq. ft.
D. Willis James' Stables, Madison, N. J.	Clinton & Russell, New York.	4,000 sq. ft.
Orthopædic Hospital, 58th Street near 3d Avenue, New York.	C. C. Haight, New York.	7,000 sq. ft.
Woodbridge Building, William and John Streets, New York.	Clinton & Russell, New York.	126,000 sq. ft.
Building, 117th Street and St. Nicholas Avenue, New York.	H. E. Cook, New York.	17,000 sq. ft.
Apartment House, 81st Street and Amsterdam Avenue, New York.	Charles Bueck, New York.	10,000 sq. ft.

BUILDING	ARCHITECT	QUANTITY OF WORK
Building, 27th Street and 4th Avenue, New York.	E. D. Lindsey, New York.	
State Street Building, Boston, Mass.	Cabot, Everett & Mead, Boston, Mass.	
Hartford Building, 17th Street and Union Square, New York.	Young & Cable, New York.	16,000 sq. ft.
Horticultural Hall, Philadelphia, Pa.	Frank Miles Day, Philadelphia, Pa.	33,000 sq. ft.
Lauderdale Building, Providence, R. I.	Stone, Carpenter & Wilson, Providence, R. I.	7,000 sq. ft.
Merritt Apartment House, 88th Street, New York.	Little & O'Connor, New York.	59,000 sq. ft.
Morrison Building, Peterboro, R. I.	———	10,000 sq. ft.
Farlow Building, Boston, Mass.	W. T. Sears, Boston, Mass.	57,000 sq. ft.
Proctor's Fifty-eighth Street Theatre, 58th Street near 3d Avenue, New York.	J. B. McElfatrick & Son, New York.	30,000 sq. ft.
Francis Building, Providence, R. I.	Stone, Carpenter & Wilson, Providence, R. I.	7,000 sq. ft.
Fahy's Building, 54 Maiden Lane, New York.	Clinton & Russell, New York.	37,000 sq. ft.
Saylesville Building, Saylesville, R. I.	———	4,000 sq. ft.
Doelger's Brewery, 234 East 55th Street, New York.	Julius Kastner, New York.	2,000 sq. ft.
Corcoran Art Gallery, Washington, D. C.	Ernest Flagg, New York.	52,000 sq. ft.
Rhode Island Hospital Building, Providence, R. I.	Stone, Carpenter & Wilson, Providence, R. I.	41,000 sq. ft.

BUILDING	ARCHITECT	QUANTITY OF WORK
Guild Apartment House, Boston, Mass.	C. A. Halstrom, Boston, Mass.	
Hartford Times Building, Hartford, Conn.	A. W. Scoville, Hartford, Conn.	
Maine Insane Hospital, Augusta, Me.	George A. Coombs, Boston, Mass.	
Cambridge Savings Bank Building, Cambridge, Mass.	C. H. Blackall, Boston, Mass.	
Franklin Building, 9-15 Murray Street, New York.	Clinton & Russell, New York.	108,000 sq. ft.
Trenton Fire Clay & Porcelain Company, Trenton, N. J.	New Jersey Steel and Iron Co., Trenton, N. J.	72,000 sq. ft.
Loft Building, 346 6th Avenue, New York.	Stephenson & Greene, New York.	15,000 sq. ft.
Russell Building, 39th Street and 5th Avenue, New York.	Clinton & Russell, New York.	32,000 sq. ft.
Hudson Building, 32-34 Broadway, New York.	Clinton & Russell, New York.	116,000 sq. ft.
Cross Street Building, Boston, Mass.	Winslow & Wetherill, Boston, Mass.	
Harris School, Boston, Mass.	T. N. Clark, Boston, Mass.	

PART II.

Official Records

Fire, Water and Strength Tests

TABLE SHOWING COMPARATIVE RESULTS OF TI
DEPARTMENT OF BUILDING

Title of Floor	Description.	Weight, Lbs. Per Square Foot	Weight, Lbs. Per Cubic Foot	Composition of Concrete
Metropolitan,	Plaster concrete, with twisted wires embedded,	48.51	57.	77. Plaster Paris, 21. Wood Chips, 2. Cocoa Fibre,
McCabe's,	Cinder concrete and special T. C. blocks,	93.22	103.	1. Cement, 2. Sand, 4. Cinder,
Hard burnt hollow tile,	"Side construction." Hollow tiles, laid with cement and covered with concrete,	80.7	112.	1. Atlas Portland, 1. Sand, 8. Cinder Ash,
Rapp's,	Cinder concrete on brick and steel bars,	90.10	83.	1. Stettin Portland, 7. Cinder,
Thomson's,	Cinder concrete mixed with special chemicals,	76.65	106.25	Special secret combinatio
Manhattan Concrete Co.,	Cinder concrete, with expanded metal hung to the beams,	80.25	105.5	1. Germania Portland, 2. Gravel, 5. Cinder,
Expanded Metal Co.,	Cinder concrete, with expanded metal laid on top of the beams,	49.57	113.75	1 Atlas Portland, 2. Fine Sand, 4. Cinder,
Guastavino,	"Dome construction" small, thin, hard-burnt tiles laid in cement,	84.32	122.4	Cement Mortar, No Floor Beams,
Roebling's,	Cinder concrete on wire-cloth arch. Suspended ceiling,	53.72	83.25	1. Cement, 2. Sand, 5. Cinder,
Central Fire-Proofing Co.,	"End construction." Porous terra-cotta hollow tile, with cinder concrete on top,	66.28	97.	Cinder Concrete, Not specified,
Columbian,	Cement concrete and special steel bars,	71.35	124.	1. Dyckerhoff Portland, 2½ Sea-sand, 5 Broken bluestone,
Fawcett,	Tubular tiles, embedded in cinder concrete,	73.95	92.5	Cinder Concrete, Not specified,
Clinton,	Special concrete arch. Wire and plaster under beams,	73.4	488.5	1. King's Windsor, 2. Plaster Paris, 4. Cinder,
Bailey's,	Cinder concrete on dovetailed sheet metal,	73.25	110.5	1. Rosendale, 1. Cinder Ash, 2. Gravel,

STS UPON FIREPROOF FLOORS, CONDUCTED BY
W YORK CITY, IN 1896-1897.

DEFLECTION			REMARKS
Hot th Load of lbs. per sq. ft. ing Firing.	Cold With Load of 600 lbs. per sq. ft. After Firing.	Permanent Deflection of Beams.	
.36″	.26″	0.″	5 hours. Maximum temperature, 2100°. Paint on beams uninjured by fire. Chips and fibre burned in lower part, charred in central, and nearly intact near the beams
.308″	.295″	0.″	5 hours. Maximum temperature, 2325°. Small breaks in the blocks exposed the ⊥ bars and beam flanges. White coat adhered to ceiling blocks.
1.84″	22″	¼″	5 hours Maximum temperature, 2100°. Tiles were broken in places under the flanges of the beams, exposing them partly. Between the beams, six of the tiles had their lower portions broken by the force of the water. The arches were otherwise in good condition after the test.
2.37″	.31″	½″	17% of the bricks were injured and some of the ⊥ bars had sagged considerably. 5 hours. Maximum temperature, 2300°.
1.77″	.38″	⅜″	Underside of concrete washed away up to the tie-rods. Beam protection crumbled away. 5 hours. Maximum temperature, 2250°.
2.54″	.47″	1.″	5 hours Maximum temperature, 2150°. Concrete at center washed out one inch above expanded metal and exposed the beam flanges.
3.″	.34″	1¼″	5 hours. Maximum temperature 2200°. Concrete and plaster washed off and expanded metal cloth removed in places by fire and water.
.71″	.22″	.167″	6 hours. Maximum temperature, 2525°. Under the influence of the heat, the center of the floor rose 71″. After firing, the arch was in excellent condition. None of the tiles fallen, and there were no signs of cracks. The water caused cracking and falling of the lower course of tiles The bricks in many places were vitrified by the heat.
4.48″	.52″	2¼″	5 hours. Maximum temperature, 1975°. Beams and concrete were red hot. Wire netting burned off in the arch Arches in good condition.
2.16″	.22″	2 5/16″	6 hours Maximum temperature not recorded. 35% of the blocks cracked and the lower section of some broke off to a depth of about 3½″. One block dropped out of its arch. All soffit tiles fell except those nearest the walls. Grates melted. After cooling, the arch was tested with a load of 1,960 lbs. per sq. ft., with a deflection of 3 41″.
4.07″	.54″	4¼″	5 hours Maximum temperature, 22 0°. Wooden sleepers charred. Concrete floor washed off up to bars. Beam protection washed away cleanly.
4½″	.87″	5½″	3 hours. Maximum temperature, 2200°. Grates melted A majority of the tiles cracked and from many of these the lower part had broken off. When the water struck the hot tiles, large pieces cracked and fell off.
2.56″	.26″	Not taken.	5 hours. Maximum temperature, 2200°. Plaster and part of beam flange protection dropped off during the firing. Concrete arch washed off, exposing the rods.
3.06″	.625″	Not taken.	5 hours. Maximum temperature, 2325°. Floor intact. Ceiling in good shape after firing, but washed off by hose stream and sheet metal exposed uninjured.

Summary of Within Test Records

IMPACT TESTS

No.	Weight	Distance Dropped	No. of Times Dropped	Effect
1	205	2′ 0″ to 4′ 10″	3	No visible effect, ...
2	205	5′ 0″	Repeatedly	Cut into composition. No wires broken, ...
3	205	5′ 0″	5	Shattered board at second blow and cut wires at fifth, . . .
4	205	4′ 0″ to 5′ 6″	9	Two wires broken and weight went through floor, ...
5	155	6′ 0″	10	Three wires broken, ...
6	155	9′ 0″	5	Three wires broken, ...

FIRE TESTS OF SECTIONS OF FLOOR

No.	Size of Furnace	Time	Load per sq. ft.	Effect
1	5′6″ x 5′¼″	2 h. 50 min.	200 lbs., . .	Affected to a depth of about ½″, ...
2	5′6⅝″ x 3′1¼″	5 hrs.	150 lbs., . .	Deflection, 1 3-22″, ...
3	5′2⅞″ x 12′6¾″	3¾ hrs.	. . . . .	Affected to a depth of about 1″, ...
4	5′0″ x 4′7″	1 hr.	. . . .	No visible effect, ...
5	14′4″ x 14′2″	5 hrs.	150 lbs., . .	Affected to a depth of about 1″, ...
6	5′6″ x 2′6¼″	3⅔ hrs.	200 lbs , . .	No appreciable effect, ...
7	18 square feet	. . . . .	. . . . .	. . . . .
8	7′0″ x 12′0″	6½ hrs.	300 lbs., . .	Affected to a depth varying from ¼″ to ½″, ...
9	. . . . .	1 hr.	. . . . .	On permanent floor, showed good results, ...
10	12′0″ x 16′0″	5 hrs.	150 and after fire test 600	(Metropolitan Floor.) Deflection, .36 in. Paint on beams still fresh and bright.
10	12′0″ x 16′0″	5 hrs.	150 and after fire test 600	(Hollow Tile Floor.) Deflection, 1.84 in. Paint on beams blistered and destroyed. . . . .

SUMMARY OF WITHIN TESTS

FIRE TESTS ON SMALL BLOCKS TO DETERMINE THE COMPARATIVE FIRE RESISTING QUALITIES OF METROPOLITAN MATERIAL AND HOLLOW TILE OF HARD BURNT CLAY, ETC.

7 Tests made at Harrison, N. J., in a Crucible and in a Heating Furnace, showed that the Metropolitan material is more infusible than Hard Burnt or Porous Terra Cotta Tile.

4 Tests made at Trenton and 1 Test made in New York showed similar results.

TESTS TO DETERMINE STRENGTH

No.	Lengths of Spans	Load in pounds per sq. ft.	Effect
32 were made	Varying from 3′9″ to 8′0″	Ranging from 420 to 2302	Not all tested to destruction

Of the above, 4 were made in sections in place in buildings in New York City, and on the result of these tests the system was passed for these buildings by the Board of Examiners.

TESTS TO SHOW PROTECTION AFFORDED TO IRON RODS IMBEDDED IN METROPOLITAN COMPOSITION

No.	Size of Block in inches	Diam. of Rod in inches	Time in Furnace	Effect
1	3x6⅛x12¼	½	10½ Min.	Rod cool enough to hold in the hand, ...
2	3x6⅛x12¼	½	11 Min.	Rod cool enough to hold in the hand, ...
3	4⅜x12x8	¾	Long enough to melt cast iron	Rod cool when taken out, .
4	3x12x12	¾	10 Min.	As cool as when put in, . .
5	4½x12x12	¾	8 Min.	Rod cool enough to hold in the hand, ...
6	4x8x12	⅝	10 Min.	Rod cool enough to hold in the hand, ...
7	4¾x8x12	. . . .	11 5-6 Min.	Rod was cooler than temperature of the atmosphere when taken from furnace, ...
8	4½x8x12	⅝	19 Min.	Rod cool enough to hold in the hand, ...

COMPARATIVE FIRE TESTS OF METROPOLITAN MATERIAL AND HOLLOW TILE OF HARD BURNT CLAY, ETC.

No.	Material	How Made	Time	Temperature	Effect
1	Tile,	In heating furnace,	26 min.	Cast iron melted,	When put into water it fell into small pieces,
2	Tile,	In heating furnace,	26⅝ min.	Cast iron melted,	Allowed to cool, it cracked and broke,
3	Metropolitan,	In heating furnace,	26 min.	Cast iron melted,	After being placed in water, bulk of material found to be unharmed,
4	Metropolitan,	In heating furnace,	26 min.	Cast iron melted,	After being placed in water, bulk of material found to be unharmed,
5	Cast iron,	In heating furnace,	19 min.	Cast iron melted,	Melted,
6	Metropolitan,	Annealing furnace,	21⅓ min.	Cast iron melted,	It took three blows of a hammer to break it,
7	Tile,	Annealing furnace,	16⅓ min.	Cast iron melted,	Broke with one blow of a hammer,
8	Metropolitan,	Heating furnace,	11¾ min.	Forced draft,	A man weighing 185 pounds jumped on block repeatedly without breaking it,
9	Tile,	Heating furnace,	9 min.	Forced draft,	Broke by a man stepping on it,
10	Metropolitan,	Annealing furnace,	37½ min		Cooled with water, then a man weighing 210 pounds jumped on block four times without breaking it,
11	Tile,	Annealing furnace,	35 min.		Cooled with water, then broken by a man stepping on it,
12	Common hard brick,	Annealing furnace,	34 min.		Easily broken with small hammer,

SUMMARY OF WITHIN TESTS

EVIDENCE THAT METROPOLITAN COMPOSITION WILL NOT CORRODE WIRE AND THAT WATER WILL NOT AFFECT THE MATERIAL

No. 1—Soaked section of floor loaded with 330 lbs. without breaking...

No. 2—Block soaked in water over 70 hours; was then placed on wires and loaded 800 lbs. to the square foot without wires cutting into it .....

No. 3—Block made three years, soaked and dried repeatedly—wires showed no signs of corrosion .....

No. 4—Opinion of Mr. John Rogers, maker of "Rogers' Groups" of statuary .....

No. 5—Opinion of an expert chemist .....

Official Comparative Tests of the Metropolitan and Hollow Tile Floors for Building Department, New York City

The following are copies of the reports of the Superintendent of Buildings of New York City, on the Comparative Tests of the Metropolitan and Hollow Tile Floors:

Department of Buildings,
[copy.] No. 220 Fourth Avenue,
New York, July 22d, 1897.

Metropolitan Fireproofing Company,
No. 871 Broadway, New York.

Gentlemen: The following is a report in detail of the Metropolitan Floor Construction, tested by fire and water, May 20th, 1897, which incorporates the reports of the several representatives of the Building Department present during the progress of the construction of test structure, conducting of the fire and water test, and of the subsequent 600-pound test, accompanied by detail drawings and photographs of tests.

Location of Test Structure.

The above test structure was located on the vacant lot at the northeast corner of Sixty-eighth street and Avenue A, New York City, 24′ 8½″ from curb on Avenue A and 63′ 5½″ from curb on Sixty-eighth street.

Drawings Showing Construction of Test Structure.

Drawing No. 112 shows a plan of brick walls and grates, a plan of the framing for test floor, a plan of the finished floor as tested, a general section parallel with the I beams and a section perpendicular to them, and an elevation of the test structure.

Drawing No. 113 gives a complete planning of the iron framing at a scale of 1″ to 1′, with sizes and weights indicated, accompanied by ¼-size details of the beam connections.

NEW YORK FIRE TEST

Drawing No. 107 gives a ¼-size detail of the central arch of the test structure, which shows the general construction of this floor system.

Foundation of Test Structure.

The brick walls of the test structure were started on a concrete foundation, which had a depth of 10″ and a projection beyond each side wall of about 9″.

Walls.

The walls, enclosing a space of 11′ by 14′ and 10′ high, in the clear, the size adopted for this series of tests, were uniformly 12″ thick. They were re-enforced at the corners and at intermediate points on the sides by 12″ buttresses and a system of buck-stays consisting of I beams and rods supporting upright braces between buttresses, the horizontal stays being firmly secured around the structure at about the level of the bottom of the floor system. (See Drawing No. 112.) Two walls on interior, 2′ 11″ high, supported the grate bars and formed flues for furnishing air to the fire, were 16″ thick up to the level of the lower grates, and 8″ thick from that point to level of upper grates, a distance of 18″. The side walls supporting grates were correspondingly 8″ and 4″ thick.

The spaces between these walls below the grates formed the ash-pits of the furnace. Air to support combustion was admitted to these pits through openings in walls at each end of same. These openings were 2′ 6″ high and 3′ wide, the flow of air through same being controlled by sheet-iron dampers.

Mortar.

The mortar used in laying walls was a common Portland cement and lime mortar.

Grates.

There were two tiers of grate-bars, one 18″ above the other. These bars were flat bars, ½″ by 3″, set in the walls 6″ between centers. (See Drawing No. 112.)

NEW YORK FIRE TEST

Flues.

Flues 15″ square were built in each of the four corners of the test structure. These were carried up to a height of about 6′ above the top of the floor level. Pieces of sheet iron were used to cover the top of flues to regulate draught.

Floor Beams.

The floor beams, 10″, 25 lb., Carnegie roll, moment of inertia 122.1, lawful bending moment 30,525′ lbs., and as used in above structure, will lawfully carry a uniformly distributed load of 311 lbs. per square foot.

There were four in number and set 4′ between centers, with a clear span of 14′, secured with two ¾″ tie-rods in each bay. The ends of beams were securely fastened to angle-irons which were placed across their ends, which in turn were fastened to channels which ran alongside of the outside beams. (See Drawing No. 113.)

Metal Work in Arch.

The material of the arch is a composition of plaster and other material, moulded out of a network of wire cables. The lower flanges of the I beams were covered with wire cloth, while wire cloth enveloped entirely the angle-irons supporting the smoke flues. Below the floor beams and running at right angles to them were suspended from the flanges of the beams, by means of special supports, 1″ by ¼″ iron bars. These bars were placed 16″ between centers and supported the wire mesh to which the plastering is applied.

Galvanized iron cables, composed of two wires 3/32″ diameter, were stretched across the whole floor, 2″ apart, and the ends secured to the two outside beams by means of hooks over the upper flanges of same.

In the middle of each span between the floor beams and running parallel to them were laid ¾″ round bars on top of the cables. These bars were then forced down until nearly touching the centering for arch, which had been previously placed, and then tied to the 1″ by ¼″ bars below the flanges by means of wires. This operation stretched the cables until very taut.

NEW YORK FIRE TEST

Material of Arch.

Centering for arch was placed about 4″ below the top of beams, and centering also placed around lower flange of beams so that they should be covered to a depth of about 2″ with the material of arch. Slabs of the material were placed against the web of the beams and plastered in.

The material arch composed by weight of

Plaster of paris	75 per cent.
Wood chip	20 "
Cocoanut fibre	2½ "
Asbestos	2½ "

This material came to the job already mixed, in bags of 100 lbs. each. When ready to use it was mixed with water to consistency of ordinary building mortar, and immediately dumped into place and rammed with shovel, setting in about 15 minutes. This mixture extended above top of beams about ½″, so that the wire cables were entirely covered.

Sleepers.

Sleepers 2″ by 4″, with beveled sides, were laid on May 14th, at right angles to I beams 18″ between centers.

The concrete fill between sleepers composed of:

8 parts of boiler ash.
1 part of Cow Bay sand.
1 part of Atlas cement.

These materials were well shoveled and mixed with a sufficient quantity of water to give same a proper consistency, and was then well rammed between sleepers. (See Photograph No. 1,278.)

Ceiling.

Ceiling was plastered on May 3d and 4th. Two coats were put on, first a brown coat, about ⅝″ thick, composed of one part plaster of paris and two parts of machine-made mortar, furnished by the United States Mortar Supply Company; second, a white coat about ⅛″ thick, composed of plaster of paris.

Time for Setting of Arch.

The plaster arch was put in place on April 13th, 1897. The concrete fill was put in place on April 14th, 1897. The fire test was made on May 20th, 1897, thus allowing 37 days for setting of plaster and 36 days for setting of concrete fill.

NEW YORK FIRE TEST

Protection During Setting.

A shed roof of boards covered with tarred paper served to protect floor from the weather during the period of setting, and a coal fire was burned on the inside of house for several days to assist in drying out the work.

Loading for Fire Test.

The central bay of the floor was loaded with pig-iron, to 150 lbs. per square foot, placed in seven piles along whole length of the bay, and so distributed that all the load came on that part of the floor between the beams. From observations taken before and after loading, the floor was found to deflect under same .04 of an inch.

Fuel and Manner of Firing.

The fuel used was cord-wood, which was piled on the upper grates to a thickness of about 2′. Shavings were placed in the grates under the wood to start fire. Kerosene was used on wood before fire was lighted. Fuel was added to fire through openings in west and north walls at intervals, when needed.

Means of Observing Temperatures and Deflections.

The temperatures during test were noted by means of the Pneumatic Pyrometer, made by Messrs. Uehling, Steinbart & Co., of Newark, N. J. Temperature plates containing plugs of lead, aluminum, glass, copper and cast-iron were also used.

Deflections were noted by means of the transit leveled at scales, mounted upon iron rods set up at the east and west ends and center of floor.

Program of Fire and Water Test.

Fire to be applied continuously for 5 hours. A temperature of 2,000 to 2,100 deg. Fahr. to be maintained for the last 4 hours, endeavoring to secure at one interval, if possible, a temperature of 2,200 deg. Fahr.

At the expiration of 5 hours, water to be applied through an 1⅛″ nozzle with 60 lbs. pressure to the interior for 15 minutes; during the first 5 minutes of which water to be directed against the ceiling, and during the remaining 10 minutes, against the walls and ceiling, principally the latter. Then the water was to be shut off on the inside and applied to the top of the floor for 5 minutes under a low pressure, flooding same, and again returning to the inside of the structure and applied to grates to entirely extinguish the fire.

NEW YORK FIRE TEST

Atmospheric Temperatures.

The average atmospheric temperature on the day of test, during hours of fire, was 64 F., wind from southeast.

Log of the Fire and Water Test.

Log of fire and water test, with a load of 150 lbs. per sq. ft., uniformly distributed over centre arch.

Time	Temperatures Deg. F.	Deflections Inches	Remarks
10.22 A.M.			Fire started.
10.26 "	1100		Lead melted.
10.28 "	1150		
10.30 "	1050	.10	Piece of plaster fell off.
10.31 "	1275		
10.32 "	1075		
10.36 "	1275		Aluminum plug bent down.
10.38 "	1525		Glass softening.
10.43 "	1450		
10.45 "	1575	.10	Glass bent with aluminum resting on top of it.
10.47 "	1650		Glass plug laying down.
10.50 "	1800		Bright fire inside, and portion of plaster falling off east wall.
10.54 "	1850		Bright flame.
10.55 "	1850		Ceiling in good shape.
10.58 "	1900		
10.59 "			Oil added to grate fires to assist combustion.
11.00 "	1900	.11	Copper plug still standing, but reduced in size.
11.04 "	1925		Copper plug gone. In the two end pits of the south wall the fire did not burn well.
11.14 "	1900		
11.15 "	1900	.16	Cast-iron plug at bright red heat.
11.16 "	1950		
11.20 "	1800		
11.25 "			Firing through west door.
11.27 "			Firing through west door discontinued.
11.30 "	2000	.19	
11.33 "	1915		
11.42 "	1850		
11.44 "			Firing through west opening.
11.45 "	1850	.20	
11.47 "			Firing discontinued.
11.50 "	2000		
11.56 "	1875		Ceiling warped but not cracked. C. I. plug still standing.
12.00 M.	1875	.235	Second bar put in with copper and cast-iron.
12.09 P.M.	1825		Copper plug melted. Here it is shown that temperature indicated by pyrometer is less than the melting point of copper, and yet copper melted readily, doubtless indicating a varied temperature at different corners.

NEW YORK FIRE TEST

Time	Temperature deg. F.	Deflections Inches	Remarks
12.15 P.M	1850	.19	Plaster still intact. Firing through west opening.
12.18 "			Firing discontinued.
12.27 "	1850		Cast-iron softening.
12.30 "	1875	.21	
12.44 "			Re-firing west opening.
12.45 "	1875	.21	
12.55 "	1825		Second bar taken out, cast-iron plug standing.
12 56 "	1775		Ceiling warped, but not cracked or broken.
12 58 "	1825		Bricked up opening at north of structure from which second bar was taken.
1.00 "	1675	.22	
1.06 "			Pyrometer tube taken from south end of structure.
1.08 "			Pyrometer tube inserted in newly bricked-up hole at north end of structure.
1.12 "			Firing west opening.
1 15 "	1700	.22	
1.18 "			Firing discontinued.
1.29 "	1825		
1.30 "	1800	.23	
1.31 "	1780		
1.35 "	1650		
1 36 "			Firing through north opening.
1.38 "	1950		
1.43 "			Firing discontinued.
1.45 "	2050	.23	
1.59 "			Firing through west opening.
2.00 "	1700	.22	
2.05 "			Firing discontinued.
2.12 "	2100		
2.15 "	1950	.26	
2.18 "			Firing through west opening.
2 24 "			Firing through west opening discontinued.
2 30 "	1875	.27	
2.35 "			Firing through west door.
2 38 "			Firing through west door discontinued.
2.45 "	1750	.31	
2.48 "			Firing through west opening.
2.55 "			Firing discontinued. Third flat bar to which was attached temperature plate, put in south opening, from which pyrometer tube had been removed, but bar soon heated and bent down, rendering same unserviceable.
3.00 "	1825	.34	
3.10 "	1800		Third plug bar removed, cast-iron plug alone was standing.
3.20 "		.36	
3.22½ "			Water on ceiling.
3 27½ "			Water off ceiling and applied to side walls and ceiling.
3.37½ "			Water off side walls and ceiling.
3.40½ "			Water on roof.
3.45½ "			Water off roof.
3.47½ "			Water on grates.
3 49½ "			Water shut off.

NEW YORK FIRE TEST

Witnesses of the Fire and Water Test.

The test was witnessed by Messrs. Edward Cooper, Charles E. Hewitt, Edmund Ketchum, H. A. Greene, J. P. Anderson, George B. Post, F. C. Thomas, Tysilio Thomas, John H. Banks, Ph.D., and Amory Coffin, representing the Metropolitan Fireproofing Company; Howard Constable, E. H. Peck, Surveyor of the Continental Fire Insurance Company, representing Mr. Moore, of same company; J. W. and F. W. Rapp, of the Rapp Floor Construction; A. L. A. Himmelwright, of John A. Roebling's Sons Company; C. S. Hill, of the Engineering News; Walter S. Faddis, representing Robinson & Wallace; Messrs. Merrill Watson and Mr. Merritt, of the Central Expanded Metal Company; Mr. R. W. Allison, of the Central Fireproofing Company; Messrs. Hewitt and Moffitt, agents for the J. W. Rapp Floor; Messrs. Ross F. Tucker and W. N. Wight, of the Manhattan Concrete Company; Messrs. E. A. [illegible]ling and Mr. Steinbart, of Newark, N. J., manufacturers of Pneumatic Pyrometer used; members of the Police and Fire Departments; representing the Department of Buildings, were Acting Second Deputy Superintendent F. M. Rutherford, Messrs. J. B. Nau, Isaac Harby, R. B. Post, David H. Baldwin, S. O. Miller, John W. Cuthbertson, A. E. Moore and William W. Ewing, engineer in charge, and on the day after fire floor was inspected by O. H. Kingsland, Surveyor of the New York Board of Fire Underwriters.

Effects of Fire and Water Test.

An examination of the ceiling after fire showed that the ceiling was down in most parts of the test structure, except near the north wall and in the northeast and northwest corners. Here it was in a warped and hanging condition, being in several places two or three inches below its original position. The wire mesh on the center and south bays was partially gone. The beam protection on the two center beams was gone except for a short distance at each end of beam. It was noticed that the *paint was still to be seen on these beams in the places where the beam protection had come off.* Material of arch between beams was washed away in some places so as to expose wire cables. A piece of material was

removed from around lower flange of beam, and it was here observed that in these pieces all combustible material, such as wood, chips and cocoanut fiber, were burned in the lower region, charred to the central part and *nearly intact in the region immediately in contact with the beam.* The material in center bay where stream of water did not reach was soft to a certain depth penetrated by a shaft stick to a depth varying between 1″ and 1¼″.

600-Pound Load Test.

On May 22d the center bay of the floor was loaded with pig-iron, evenly distributed over whole area between beams, to 600 lbs. per square foot. The load was so placed that none of it came directly on the beams. From readings taken before and 48 hours after the application of load it was found that the center of bay had deflected .26 of an inch.

Witnesses of 600-Pound Load Test.

600-pound load test was witnessed by I. Hardy, of the Department of Buildings, and Mr. H. A. Greene, of the New Jersey Steel and Iron Company.

Permanent Set of Beams.

After fire and water and load test the upper flange of the two center beams was stripped of all material and the permanent deflection of same measured and found to be: for the north beam, none; for the south beam, none.

List of Photographs.

No. 1,273, Metropolitan Test. Floor in process of construction. 11:45 A. M., April 13th, 1897. (Looking north.)

No. 1,276, Metropolitan Test. Arches partly in. 2:15 P. M., April 13th, 1897. (Looking north.)

No. 1,278, METROPOLITAN Test. Concrete fill being placed. 11:25 A. M., April 14th, 1897. (Looking north.)

No. 1,329. METROPOLITAN Test. General view during fire. 11:45 A. M., May 20th, 1897. (Looking west.)

No. 1,332, METROPOLITAN Test. Firemen applying water on interior. 3:25 P. M., May 20th, 1897. (Looking southwest.)

No. 1,342, METROPOLITAN Test. Northeast corner of ceiling after fire. 10:50 A. M., May 21st, 1897. (Looking up.)

Rough sketch of appearance of ceiling on the day after fire and water test.

Very respectfully,

(Signed) STEVENSON CONSTABLE,
Superintendent of Buildings.

DEPARTMENT OF BUILDINGS.

[COPY.] No. 220 Fourth Avenue,
NEW YORK, July 22d, 1897.

Metropolitan Fireproofing Company,
No. 874 Broadway, New York.

GENTLEMEN: I desire to extend to you a copy of the report in detail of the 10" Hard Burned Hollow Tile Floor Construction, tested with fire and water May 20th, 1897, which incorporates the reports of the several representatives of the Building Department present during the progress of construction of test structure, conducting of the fire and water test and of the subsequent 600-pound load test, accompanied by detail drawings and photographs of test.

LOCATION OF TEST STRUCTURE.

The structure in which this test was made was located on a vacant lot at the northeast corner of Sixty-eighth street and Avenue A, New York City, 24′ 2½″ from the curb line of Avenue A, and 41′ 4½″ from the curb line of East Sixty-eighth street.

DRAWINGS SHOWING CONSTRUCTION OF TEST STRUCTURE.

Drawing No. 111 shows a plan of the brick walls and grates, a plan of the framing for test floor, a plan of the finished floor as

tested, a general section parallel with the I beams and a section perpendicular to them, and an elevation of the test structure.

Drawing No. 110 gives a complete planning of the iron framing at a scale of 1″ to 1′, with sizes and weights indicated, accompanied by ½-size details of the beam connections.

Drawing No. 103 gives a ¼-size detail of the center arch of the test structure, which shows the general construction of this floor system.

Foundation of Test Structure.

All four walls of the test structure rested on a bed of concrete, of average width, of 2′ 4″ by 8″ deep.

Walls.

The walls enclosing a space of 11′ by 14′, and 10′ high in the clear, the size adopted for this series of tests, were uniformly 12″ thick. They were re-enforced by a system of buck-stays placed just below the level of ceiling, with upright braces on each side.

Two walls on interior, 2′ 11″ high, supporting the grate-bars and form-flues for furnishing air to the fire, were 16″ thick up to the level of the top of the lower grates, and 8″ thick from that point to top of upper grates, a distance of 18″. The side walls supporting grates were correspondingly 8″ and 4″ thick.

The spaces between these walls below the grates formed the ash-pits of the furnace. Air to support combustion was admitted to these pits through openings in walls at each end of same. These openings were 2′ 6″ high, and 3′ wide, the flow of air through same being controlled by sheet-iron dampers.

Mortar.

The mortar used in laying walls was Portland cement mortar.

Grates.

There were two tiers of grate-bars, one 18″ above the other. These bars were flat bars, 3″ by ½″, set in the walls 6″ between centers. (See drawing No. 111.)

NEW YORK FIRE TEST

Flues.

Flues 15″ square were built in each of the four corners of the test structure. These were carried up to a height of 6′ above the top of the floor level. Pieces of sheet-iron were used to cover top of flues to regulate draught.

Floor Beams.

The floor beams were 10″, 25 lb., Carnegie roll, moment of inertia, 122.1, lawful bending moment, 30,525 ft. lbs., and as used in above structure will lawfully carry a uniformly distributed load of 311 lbs. per square foot. There were four in number and set 4′ between centers with a clear span of 14′, secured with two ¾″ tie-rods in each bay. The ends of beams were securely fastened to angle-irons, which were placed across their ends, which in turn were fastened to channels which ran alongside of the outside beams.

Material of Arch.

The floor arch consists of a hollow tile arch 10″ deep. (See Photograph No. 1,274 and Drawing No. 103.)

Board centering was suspended 1¼″ below bottom of beams to receive the arch. (See Photograph No. 1,269.) Each separate arch contained two skew-backs, four voussoirs and one key. The transverse joints were broken as much as possible. Wherever a tie-rod of the floor beams did not fall into a joint a corner was knocked off the tile in order to make room for it. If the tie-rod came too far away from the joint, a tile was split in two, and the lower part was stuck under the tie-rod, and another piece was put on top of it. These hollow spaces were filled with cement and broken pieces. The cement mortar used contained about one-half sand. The joints were about ¼″ thick. Scarcely any cement was put in the transverse joints. In some cases where there was much space between the joints and the tie-rods a few bricks were put in to fill it up.

NEW YORK FIRE TEST

The arches were all completed at 11:30 A. M., April 13th, 1897. (See Photograph No. 1,274.)

Sleepers.

On May 14th the sleepers and concrete filling were laid. Sleepers 2″ by 4″ with beveled sides were laid at right angles to I beams, 18″ between centers.

The concrete fill between sleepers composed of:

8 parts of boiler ash.
1 part of Cow Bay sand.
1 part of Atlas cement.

These materials were well shoveled and mixed with a sufficient quantity of water to give same a proper consistency and then well rammed between sleepers.

Ceiling.

Ceiling was plastered on May 3d and 4th. Two coats were put on, first a brown coat about $\frac{5}{8}$″ thick, composed of one part plaster of paris and two parts of machine-made mortar, furnished by the United States Mortar Supply Company; second, a white coat about $\frac{1}{8}$″ thick, composed of plaster of paris.

Time for Setting of Arch.

The hollow tile arch was put in place on April 13th, 1897. The concrete fill was put in place on April 14th, 1897. The fire test was made on May 20th, thus allowing 37 days for setting of arch and 36 days for setting of concrete fill.

Protection During Setting.

A shed-roof of boards covered with tarred paper served to protect floor from the weather during the period of setting, and a coal fire was burned on the inside of house for several days to assist in drying out the work.

NEW YORK FIRE TEST

Loading for Fire Test.

The central bay of the floor was loaded 150 lbs. per square foot, with pig-iron placed in seven piles along the whole length of the bay, and so distributed that all the load came on that part of the floor between the beams. (See Photograph No. 1,321.) From observations taken before and after loading, the floor showed no deflection.

Fuel and Manner of Firing.

The fuel used was cord-wood, which was fired on two grates, one above the other; the vertical distance between them was 18". The cord-wood was piled on the upper grate to an even thickness of 24". Shavings and kerosene oil were used to start the fire. Fuel was added at intervals, as required, through west and south openings. These firings were sometimes on the lower and sometimes on the upper grates. 5½ cords of wood were used.

Means of Observing Temperatures and Deflections.

The temperatures during test were noted by means of the Pneumatic Pyrometer, made by Messrs. Uehling, Steinbart & Co., of Newark, N. J. Temperature plates containing plugs of lead, aluminum, glass, copper and cast-iron, and a Platin-Rhodium Pyrometer were also used. Deflections were noted by means of the transit leveled at scales mounted on iron rods set up at the east and west ends and center of floor.

Program of Fire and Water Test.

Fire to be applied continuously for five hours. A temperature of 2,000 to 2,100 deg. Fahr. to be maintained for the last 4 hours, endeavoring to secure at one interval, if possible, a temperature of 2,300 deg. Fahr. At the expiration of 5 hours water to be applied through a 1⅛" nozzle, with 60 lbs. pressure, to the interior for 15 minutes; during the first 5 minutes of which water to be directed against the ceiling, and during the remaining ten minutes against the walls and ceiling, principally the latter. Then the water was to be shut off on the inside and applied to the top of the floor

for five minutes under a low pressure, flooding same, and again returned to the inside of the structure and applied to grates to entirely extinguish the fire.

Log of Fire and Water Test.

Log of fire and water test with a load of 150 lbs. per sq. ft. evenly distributed over the central arch:

Time	Temperatures Deg. F.	Deflections Inches	Remarks
10.22 A.M.			Fire started.
10.25 "	1125		Lead is melting.
10.30 "	1250		Piece of plaster fell off.
10.32 "	1250		Aluminum is melting.
10.35 "		.08	
10.40 "	1525		Glass is melting.
10.44½ "	1650		Glass completely melted.
10.45 "	1625	.31	
10.47 "	1675		
10.50 "	1825		Bright fire inside.
10.52 "	1900		
10.54 "	1900		
10.55 "	1900		Ceiling is peeling a little all over.
10.58 "	2000		
11.00 "	2000	.38	Copper and C. I. plugs still intact.
11.15 "	1950	.37	
11.16 "	1950		
11.30 "	1975	.41	Re-firing west opening.
11.32 "			Firing west opening discontinued.
11.40 "	2050		Copper and C. I. plugs both intact.
11.45 "	2000	.44	
11.48 "			Re-firing west opening.
11.50 "			Re-firing west opening discontinued.
11.59 "			First rod removed with C. I. and copper plugs intact. The copper plugs fell out of rod after being removed, and seemed intact
12.00 M.	1850	.52	
12 01½ P.M.	1850		Second rod put in.
12.02 "	1850		Lead plug melted.
12.03 "	1850		Aluminum and glass plugs melted.
12.15 "	1775	.65	
12.20 "			Re-firing west opening.
12.22 "			Re-firing west opening discontinued.
12.27 "	1900		Copper plugs begin to melt, C. I. intact.
12.30 "	1850	.77	Copper plug melted.
12.45 "	1750	.91	
12.47 "			Re-firing west opening.
12 52 "			Re-firing west opening discontinued.

NEW YORK FIRE TEST

Time	Temperatures Deg. F.	Deflections Inches	Remarks
1.00 P.M.	1850	1.03	It was noticed that ceiling plaster had fallen down in many places.
1.05½ "	1825		Second plug bar removed, with C. I. plug still standing intact.
1.13 "	1600		
1.15 "	1600	1.15	
1.21 "	1500		Rod taken out of south opening.
1.27 "			Rod put in north opening, re-firing west opening. Preparations were now made to use the Platin-Rhodium pyrometer.
1.30 "	1600	1.22	
1.34 "			Re-firing west opening discontinued.
1.45 "	1675	1.30	
1.48 "			Firing southwest small opening.
1.50 "			Ceased firing.
1.51 "			Re-firing southeast small opening.
1.52 "			Ceased firing.
1.53 "			Firing lower grates from the south.
1.59 "			Re-firing west opening.
2.00 "	1675	1.39	At this time a comparison of readings between the two pyrometers (Platin-Rhodium and Uehling), and the agreement was as close as possible to make readings.
2.05 "			Re-firing west opening discontinued.
2.15 "	1900	1.49	
2.24 "			Re-firing west opening.
2.30 "	1900	1.60	Re-firing west opening discontinued.
2.39 "			Re-firing west opening.
2.45 "	1900	1.66	Re-firing west opening discontinued.
2.49 "	2080		A third flat bar, with plug bar fastened at its end in the direction of the bar, was inserted. This bar bent down after it had been observed at 2.50.
2.50 "	2100		Lead, aluminum, and glass plugs had melted.
2 55 "	1975		Bar had bent too far for any further observations.
3.00 "	2000	1.74	
3.09 "	1950		
3.10 "	1900		Pyrometer tube taken out. Plug-bar pulled out, with C. I. plug still standing and copper gone
3.20 "		1.84	
3.22½ "			Water put on at an average pressure of 60 lbs. The water stream was kept playing over the ceiling for five minutes.
3 27½ "			The water was directed on ceiling and side walls, but mostly ceiling.
3.37½ "			The water was stopped inside the structure.
3.41½ "			Water under hydrant pressure was poured on top of roof. It was noticed that the roof up to this moment showed no sign of a crack.
3.46½ "			Water off roof.
3.48 "			Water on grate-bars to extinguish fire.
3.50 "			Water shut off.

NEW YORK FIRE TEST

Atmospheric Temperatures.

The average temperature observed during the test was 64 deg. Fahr. The wind was blowing from the southeast.

Witnesses of the Fire and Water Test.

The test was witnessed by Messrs. Edward Cooper, Charles E. Hewitt, Edmund Ketchum, H. A. Greene, J. P. Anderson, George B. Post, F. C. Thomas, Tysilio Thomas, John H. Banks, Ph.D., and Amory Coffin, representing the Metropolitan Fireproofing Company; Howard Constable, E. H. Peck, Surveyor of the Continental Fire Insurance Company, representing Mr. Moore, of same company; Messrs. J. W. and F. W. Rapp, of the Rapp Floor Construction; A. L. A. Himmelwright, of John A. Roebling's Sons Company; C. S. Hill, of the Engineering News; Walter S. Faddis, representing Robinson & Wallace; Messrs. Merrill Watson and Mr. Merritt, of the Central Expanded Metal Company; Mr. R. W. Allison, of the Central Fireproofing Company; Messrs. Hewitt and Moffitt, agents for the J. W. Rapp Floor; Messrs. Ross F. Tucker and W. N. Wight, of the Manhattan Concrete Company; Messrs. E. A. Uehling and Mr. Steinbart, of Newark, N. J., manufacturers of Pneumatic Pyrometer used; members of the Police and Fire Departments; representing the Department of Buildings were Acting Second Deputy Superintendent F. M. Rutherford, Messrs. J. B. Nau, Isaac Harby, R. B. Post, David H. Baldwin, S. O. Miller, John W. Cuthbertson, A. E. Moore and William W. Ewing, engineer in charge, and on the day after fire floor was inspected by O. H. Kingsland, Surveyor of the New York Board of Fire Underwriters.

Effects of Fire and Water Test.

The sketch shows the appearance of the floor after fire and water test. In this sketch only the places where some of the tiles had been broken off under the stream of water are shown. At A the lower part of the tiles had been broken away by the water, the inside portions of the tiles were exposed. In other places directly under the flanges of the beams the tiles were broken and exposed the flanges partly. The ceiling plaster was almost all down, even where not struck by the water. Photograph No. 1,337 shows the ceiling after the fire.

NEW YORK FIRE TEST

600-Pound Load Test.

On May 22d the central bay of the floor was loaded with pig-iron, evenly distributed over whole area between beams, to 600 lbs. per square foot. The load was so placed that none of it came directly on the beams. From readings taken before and 48 hours after the application of load it was found that the center of bay had deflected .22 of an inch.

Witnesses of 600-Pound Load Test.

Isaac Harby, of the Department of Buildings, and H. A. Greene, of the New Jersey Steel and Iron Company.

Permanent Set of Beams.

The permanent set of beams used in test floor to the fire, water and load test was as follows:

On north central beam 1/4" light in the center.

On south central beam 3/16" full in the center.

List of Photographs.

No. 1,269, Hard Burned Hollow Tile Test. Iron beams and centering in place. 3:17 P. M., April 12th, 1897. (Looking southwest.)

No. 1,274, Hard Burned Hollow Tile Test. Arches in place. 12 M., April 13th, 1897. (Looking west.)

No. 1,321, Hard Burned Hollow Tile Test. Floor loaded 150 lbs. per square foot just before firing. 9:45 A. M., May 20th, 1897. (Looking southwest.)

No. 1,337, Hard Burned Hollow Tile Test. Southeast corner of ceiling after fire. 11:45 A. M., May 21st, 1897. (Looking up.)

No. 1,345, Hard Burned Hollow Tile Test. Floor loaded 600 lbs. per square foot after fire. 10:55 A. M., May 22d, 1897. (Looking southwest.)

Very respectfully,

(Signed) Stevenson Constable,
Superintendent of Buildings.

Report of
Ricketts & Banks
on
New York Fire Test

[COPY.]

RICKETTS & BANKS,
Chemists, Assayers and Mining Engineers,
104 John Street.

Cable Address, "Ricketts," New York.

PIERRE DE P. RICKETTS, E.M., PH.D.
JOHN H. BANKS, E.M., PH.D.

E. RENSHAM BUSH, E.M.,
Associate Mining Engineer.

NEW YORK, June 1st, 1897.

Metropolitan Fireproofing Company,
871 Broadway, New York.

GENTLEMEN: In accordance with your request, our Dr. Banks was present at and carefully followed the tests made May 20th, to determine the comparative fire-resisting qualities of hard-burnt hollow clay tile and the fireproofing material prepared by your company.

You are familiar with the dimensions and construction of the two houses, or ovens, in which the tests were made, and we omit these details from the present report. The two buildings appeared to differ only in the construction of the ceilings and overlying flooring, these being constructed in one house according to your own system and in the other of the tile already described. The temperatures in the two houses were measured by pneumatic pyrometers of the same make (Uehling, Steinbart & Co.), and which were said to have been standardized and found to agree in registration. As a check on the pyrometers, small cylinders of lead, aluminum, glass, copper and cast-iron were placed in the houses in positions corresponding to those occupied by the pyrometer tubes. The fires were lighted at 10:22 A.M. Pyrometric readings began at 10:30 and were continued as per the following table:

NEW YORK FIRE TEST

Time	*Metropolitan House.*	*Tile House.*
10:30	1,050 F.	1,250 F.
10:40	1,375	1,375
10:43	1,525	1,575
10:45	1,575	1,625
10:50	1,800	1,800
10:58	1,875	2,000
11:00	1,875	2,025
11:01	1,900	2,050
11:05	1,900	2,050
11:15	1,900	1,950
11:22	1,800	1,950
11:27	1,950	1,950
11:28	2,000	1,950
11:30	2,000	1,975
11:36	1,825	2,000
11:45	1,950	1,950
12:00	1,875	1,850
12:10	1,825	1,825
12:16	1,850	1,825
12:30	1,850	1,850
12:45	1,850	1,725
1:00	1,750	1,850
1:12	1,475	1,625
1:17	1,750	1,550
1:20	1,850	....
1:25	1,875	....
1:31	1,775	1,600
1:34	1,725	1,725
1:38	1,850	1,725
1:39	1,900	1,750
1:41	2,000	1,750
1:42	2,025	1,725
1:45	2,025	1,675
1:47	1,975	1,675
1:50	1,925	1,800
1:51	1,900	1,775
1:53	1,800	1,800
2:00	1,650	1,650
2:02	1,900	1,825
2:04	1,950	1,850
2:05	1,900	1,800
2:07	1,950	1,875
2:09	2,050	1,900

NEW YORK FIRE TEST

Time	*Metropolitan House*	*Tile House*
2:10	2,075	1,950
2:11	2,100	1,925
2:15	2,050	1,925
2:18	1,950	1,875
2:18	1,825	1,875
2:21	1,825	1,850
2:23	2,000	1,800
2:24	2,050	1,825
2:26	1,975	1,650
2:30	1,825	1,875
2:34	1,625	1,950
2:36	1,825	1,900
2:37	1,925	1,825
2:40	1,950	1,725
2:49	1,775	2,000
2:50	1,850	2,100
3:02	1,850	2,000
3:07	1,850	2,000
3:09	1,825	1,925
3:10	1,800	1,900

At 11:05 the copper cylinder in the METROPOLITAN house had fused, while that in the tile house remained intact.

At 11:50 new sets of cylinders were placed in both houses. When the first set was removed from the tile house the copper rod was still in position.

At 12:10 the second copper cylinder had fused in the METROPOLITAN house; that in the tile house had fused at 12:25.

At 1:06 the pyrometer tube in the METROPOLITAN house was transferred to the hole previously occupied by the set of test cylinders. A similar transfer was made in the tile house at 1:20. They were again reconnected with the registering scales at 1:08 and 1:28, respectively.

A thermometer was so placed on the roof of each test house that its base rested on what would be a portion of the floor immediately under the wood flooring. The readings of these thermometers were as follows:

Time	*Metropolitan House*	*Tile House*
10:46	60 F.	60 F.
10:59	66	66

NEW YORK FIRE TEST

Time	*Metropolitan House*	*Tile House*
12:05	88	103¾
1:14	98	128
2:28	98	128
3:20	117 (max.)	134 (max.)

The roof deflections obtained were as follows:

11:35	18-100 in.	40-100 in.
12:02	23-100	43-100
12:53	20-100	90-100
1:17	20-100	103-100
2:07	22-100	143-100
3:00	36-100	184-100
After quenching	19-100	28-100
Immediately after loading to 600 lbs.	44-100	41-100
After 600 lbs. load had been on 48 hours	45-100	43-100

Each fire was quenched by a stream of water turned on from a fire engine at 3:22. The stream was kept on at full head for 15 minutes, during which time it was directed almost entirely against the ceilings of the houses. At the end of 15 minutes the hose was transferred to the tops of the houses and the water was played on the flooring at reduced pressure for 5 minutes.

The protective qualities of the two systems of fireproofing are best measured in this test by the effect of the heat on the iron beams which the fireproofing materials were intended to protect. The readings of the thermometers on the roofs show that the METROPOLITAN system is superior to the tile system in non-conductivity of heat. The deflection records furnish corroborative evidence of this. The most conclusive evidence of the superior non-conducting quality of the METROPOLITAN material is, however, found in the appearance of the surfaces of the lower flanges of the beams. In the tile house the paint on such surfaces was completely burnt off and a scale of red and magnetic oxides of iron had formed. In the METROPOLITAN house the paint on the lower flanges of the beams had not been perceptibly affected; it could be scraped off in pieces which exhibited the properties, such as elasticity and toughness, possessed by the paint before the test. In our opinion this unaltered condition of the paint on the beams in the METROPOLITAN house is the strongest possible evidence that the

beams in this house could not have been much heated during the test. Further evidence of the high non-conductivity of the METROPOLITAN material is found in the fact that the wood used in the composition remained unaltered in that portion in contact with the metal beams. This proves conclusively that the temperature at which wood chars was not reached in the back portion of the beam-covering in the METROPOLITAN house. The unaltered condition of the paint on the beams in this house shows that the temperature reached must have been considerably under the wood-charring temperature; otherwise, the paint would at least have blistered.

Reference to photographs taken of the ceilings after the tests will show that the ceiling in the METROPOLITAN house was washed down where the full force of the fire engine stream struck. At other points it remained in position.

While the tile ceiling resisted the force of the water much better than the METROPOLITAN, it was inferior to the latter in its protection of the metal beams against the fire.

Yours respectfully,

RICKETTS & BANKS.

Fire Test of Metropolitan Fireproofing Company's Floor for the Building Department of the City of Boston, Mass.

A rectangular structure was made 6′ high, the sides being 12′ long and the ends 7′ long. The walls were 12″ thick, and of brick, reinforced at the corners of the structure and in the middle of each side by piers 16″ square. Transversely with the 12′ walls, and resting on them, were placed three 6″ steel beams, 5′ 2″ apart, center to center. On these beams were constructed a floor, there being two bays. The distance between the cables was 2″, and the thickness of floor-plate was 4½″. The area of the floor was 72 square feet. As constructed, the floor formed the top of a furnace, and would thus be exposed to the maximum effect of a fire burning within. In order to determine the effect of a fire on both a loaded floor and one that was not loaded, cast-iron plates were distributed over the top surface of one bay until the load amounted to 300 pounds per square foot, while the other bay remained without load, its top surface, therefore, being at all times in open view. At 9:00 A. M. a fire of hard wood was built, and was kept burning intensely until 3:30 P. M. The heat was so great that large cracks were developed in the sides and ends of the brick walls by expansion. Throughout the entire time the iron beams, protected by the composition, remained cold, and the non-conduction qualities of the composition were further emphasized by the fact that those witnessing the test walked around from time to time on the unloaded bay, examining the loading and the condition of the upper surface of the composition. At all times during the test the top surface of the composition remained so cool that the hand could be placed on it without inconvenience. Some days later, the fire having entirely died out, the composition was carefully examined, when it was found that the under surface, which was exposed to the flames, was affected to a depth varying from ¼″ to ½″. A light scratching, with a skim coat of plaster,

would have been sufficient to make a finished ceiling. The strength of the floor was unimpaired, and after two and a half months' exposure to the weather the surface remained unchanged.

Under the direction of the superintendent of Boston Board of Underwriters, in the presence of the Commission of Buildings and his chief inspector. The tests were instituted by Mr. W. T. Sears, architect. Several systems were tested at one time, among them the METROPOLITAN, test houses being erected for the purpose.

At the end of the test the only perceptible damage was that done to the brick party wall. A question in regard to the comparative weights of the materials used in the construction of the different roofs having been raised, it was decided to weigh a section of each. The data thus gathered are here tabulated:

Test Number	CONSTRUCTION	Area of Section in Square Feet	Total Weight, in Pounds	Weight per Square Foot, in Pounds
1	Roebling system	18	1,295	72
2	METROPOLITAN FIREPROOFING Co.'s system	18	427	23.7
3	Expanded Metal Company's system	22.5	1,687	75.4
3a	Same as No. 3, with additional flat ceiling	22 5	1,814	8 :.6
4	Eureka system	20.25	1,648	81.3
5	Porous, hollow tile arch blocks, covered with concrete 2″ thick	20 25	1,781	87.95

In considering this table it should be noted that all of the floors were plastered on the under side, and were concreted on top, ready to receive the wood floors. The plastering on No. 5 fell during the fire-test, and was removed with the debris, and, consequently, not weighed with the other material; the weight of the 12″ stud floor-beams is not included in the weight given above.

Completeness is not claimed for any of the above tests. It was thought, however, that the tests offered valuable suggestions, and threw many new lights on the subject of fireproof construction.

Miscellaneous Fire Tests

RICKETTS & BANKS,
Chemists, Assayers and Mining Engineers,
104 John Street.

Cable Address, "Ricketts," New York.

PIERRE DE P. RICKETTS, E.M., PH.D.
JOHN H. BANKS, E.M., PH.D.

E. RENSHAM BUSH, E.M.,
Associate Mining Engineer.

[COPY.]

NEW YORK, June 8th, 1896.

Metropolitan Fireproofing Company,
No. 874 Broadway, New York, N. Y.

GENTLEMEN: We have to report that on the 6th inst. a number of tests were made under the supervision of our Dr. Banks, to determine the behavior at very high temperatures of samples of your fireproofing materials as compared with hard-burnt clay, hollow floor tile and porous terra-cotta hollow partition tile. The samples were delivered to Dr. Banks by Mr. E. D. Lindsey. The hard-burnt hollow floor tiles were stamped, "Henry Maurer & Son, N. Y." The porous partition tiles are said to have been made by the Perth Amboy Terra Cotta Company. The tests were made at the steel works of the Benjamin, Atha & Illingsworth Company, Harrison, N. J., some in the furnace used for melting crucible steel, and others in the steel heating furnaces. The furnace temperatures were measured by the Optical Pyrometer of Noul and Mesure.

TEST NO. 1

In this the samples tested were a block of the METROPOLITAN FIREPROOFING COMPANY'S material, measuring 2″ by 4 1/16″ by 7¾″, and a portion of a porous terra-cotta hollow partition tile, measuring 4″ by 6⅜″ by 6½″ long on top side, and 6⅛″ long on bottom side. These samples were placed in the hottest part of the heating furnace at 11:15½ A. M. At 11:25½, when the furnace door was raised to permit of an inspection of the samples, it was seen that the porous terra-cotta tile had fallen apart at the dividing wall. THE METROPOLITAN BLOCK appeared to be intact at this time. At 11:37½ both samples were withdrawn from the fur-

nace, the full time of exposure to the heat of the furnace having been 22 minutes. The porous terra-cotta tile had separated into three pieces. The clay had softened and was pasty. When cold it was found to be very friable. THE METROPOLITAN BLOCK came out unbroken, although the corners and edges were more or less rounded where the highly heated exterior material had become friable.

TEST NO. 2

The samples used in this test were a 3¼″ block of the METROPOLITAN FIREPROOFING COMPANY'S material, and a 4″ porous terra-cotta hollow partition tile. Both samples were surrounded with fire brick, except the top surface, which was subjected to the full intensity of the heat. These samples were put in the heating furnace at 1:16 P. M., and taken out at 3:20, giving an exposure of 2 hours 4 minutes. During this test one of the protecting bricks fell away from each sample, so that in addition to the full time exposure of the top surfaces, one side of the METROPOLITAN sample and one end of the porous terra-cotta samples were exposed during a portion of the time. The temperature in the furnace averaged about 2,417 deg. Fahr. during the test. When the samples were removed from the furnace, it was found that the porous terra-cotta tile was in a viterous state. It had undergone considerable fusion, and at the moment of withdrawal from the furnace it was quite pasty. THE METROPOLITAN BLOCK was found to have shrunk in size, but there was no indication of fusion. It retained its original form.

TEST NO. 3

In this test the following five samples were used: A hard-burnt clay hollow floor tile 5″ by 8″ by 12″, with walls 13/16″ thick. A porous terra-cotta hollow partition tile 4¼″ by 6½″ by 12½″, with ¾″ central wall, 1″ top and bottom walls, and 1¼″ side walls. A block of the METROPOLITAN FIREPROOFING COMPANY'S material, 4″ by 6½″ by 8⅛″. A second block of same material 2⅞″ by 6″ by 12¼″. And fifth, a third block of the METROPOLITAN material, 2″ by 3⅝″ by 7½″. These samples were put in the heating furnace at 1:35 P. M. and taken out at the end

of 2 hours. When the door of the furnace was opened at 1:50 it was seen that one compartment of the hard-burnt floor tile had dropped in and a portion of one side had fallen away. Also, that the top of the porous terra-cotta tile was quite badly cracked. The blocks of METROPOLITAN material showed no material change. At this time the pyrometer indicated 2,302 deg. Fahr. At 2:03 the hard-burnt tile floor had collapsed, so that the web and top rested upon the bottom. The top of the porous terra-cotta tile was also at this time badly broken and sagged. THE METROPOLITAN BLOCKS had grown smaller, but appeared to be intact. The pyrometer at time indicated 2,417 deg. Fahr. A lump of cast-iron was placed in the furnace at 2:14, and when the furnace door was again opened, 7 minutes later, this was in a liquid state on the bottom of the furnace. At 2:25 the two clay tiles were in pasty masses. The smallest of the three METROPOLITAN BLOCKS had disappeared, apparently having fluxed with the bottom of the furnace. The 2⅞" by 6" by 12¼" block of METROPOLITAN material had grown quite small at this time. The 4" by 6½" by 8⅛" block of the same material had begun to flux at the bottom and had diminished in size, but otherwise was standing the exposure very well. The pyrometer at 2:50 indicated 2,552 deg. Fahr. At the end of the two hours the two tile samples were pasty masses. Two of the METROPOLITAN BLOCKS had disappeared and but a small portion of the largest block remained.

TEST NO 4

In this test a block of the METROPOLITAN FIREPROOFING COMPANY'S material, 3" by 6⅛" by 12¼", was used. A ½" hole was bored longitudinally into this block from one end to within 3" of the other end. Into this hole was first placed a tightly-fitting iron rod 6" long; a short roll of thin paper was next put in and the end of the hole was then tamped full of the crushed fireproofing material. This sample was placed in the furnace at 2.08 and taken out at 2:18½. As soon as out of the furnace the block was broken and the rod and paper picked out with the fingers. The rod was warm, but was held in the fingers without any discomfort. The paper showed no trace of charring nor injury of any kind. The fireproofing material had charred to a depth of 9-16", leaving 1⅞" of interior practically unaltered.

MISCELLANEOUS FIRE TESTS

TEST NO. 5

For this a block was prepared in the same manner as for Test No. 4, except that the paper was left out. This and an 8″ hard-burnt clay hollow floor tile were put into the furnace at 2:59. At 3:03 the tile had cracked at the top, and at 3:10 it had collapsed. Both samples were withdrawn as soon as the tile broke down, having been in the furnace 11 minutes. The block of METROPOLITAN material was broken open as soon as out of the furnace, and the enclosed iron rod taken in the hand as before. It was warm, but could be held in the unprotected hand. In this test the charring had reached a depth of $\frac{5}{8}$″, leaving $1\frac{3}{4}$″ of interior practically unaltered.

TEST NO. 6

In this test the following three samples were treated. Three 3″ by 6″ by 12″ METROPOLITAN FIREPROOFING COMPANY's blocks piled on the sides, making a pile 9″ by 6″ by 12″. An 8″ hard-burnt hollow floor tile, lying on two porous clay tiles, which in turn rested on a square slab of METROPOLITAN material. And, third, a 4″ porous terra-cotta tile, lying on two porous clay tiles, which rested on a square slab of METROPOLITAN material. These were put into the heating furnace at 4 P. M. and withdrawn at 4:30. The hard-burnt floor tile was broken at the top at 4:16, and at 4:30 had collapsed completely. The porous terra-cotta tile had lost a lower corner at 4:12, and at 4:30 it was badly slagged and pasty, with a bad crack about one-third from one end. The METROPOLITAN BLOCKS were lifted out one at a time, by taking hold of one corner with a pair of tongs. The lowest one, which rested on the bottom of the furnace, was fluxed on the bottom side and was damaged somewhat by the tool as the pile was moved about the furnace. The two upper blocks came out in good condition, although somewhat shrunken and weakened at the exterior. When broken, the fracture of these blocks showed at the exterior a white, friable shell; next to this was a stratum of charred material, the combined depth of the two being about $\frac{3}{4}$″, and then a core of unaltered material, in which the chips retained their original color, and which appeared to retain its original strength.

MISCELLANEOUS FIRE TESTS

TEST NO. 7

In this test the samples were put into uncovered plumbago crucibles, in the crucible steel melting furnace, the temperature of which was shown by the pyrometer to be 2,552 deg. Fahr. The samples tested were: Two blocks of the METROPOLITAN FIREPROOFING COMPANY'S material measuring 2⅛″ by 4⅛″ by 7⅝″, and 3⅛″ by 6″ by 8⅝″ respectively. A portion of a porous terra-cotta hollow tile 4″ by 6⅛″ by 11¾″, with ¾″ inner and 1″ outer walls. And, fourth, a portion of an 8″ hard-burnt hollow floor tile, with ¾″ walls. The two blocks of METROPOLITAN material were put into one crucible and other samples into separate crucibles. The samples were put into hot crucibles at 5:55, and the crucibles were withdrawn at 6:55. At the end of the test the smaller of the blocks of METROPOLITAN material had melted down, but of the larger a portion remained. The upper corners of this larger block not touching the crucible were found to be in practically the same condition as before the test. The melting of the balance of these two blocks was undoubtedly hastened by the fluxing action of the clay of the crucible. The porous terra-cotta tile was found in the bottom of the crucible as a viscous mass. The hard-burnt hollow floor tile had lost its form and had become a stiff, pasty mass.

Our observations during the above-described tests, and the results obtained, have led us to the following conclusions:

The METROPOLITAN material is more infusible than the clay of either of the tiles tested. When not in contact with firebrick or other fluxing matter it was infusible at the highest temperaure reached in the tests, while under the same conditions the clay tiles lost their form and became pasty.

The high temperature produces only surface cracks in the METROPOLITAN material, while in the clay tiles it causes fractures which destroy the tiles. While in clay tiles collapse is likely to occur from cracks formed by the sudden heating long before the softening point is reached; in the case of the METROPOLITAN material there is a gradual disintegration, and collapse does not occur until this disintegration has penetrated so far that the unaltered interior becomes so reduced in mass as to lack the strength requisite to resist crushing by the weight upon it. This disintegration proceeds slowly, and where a considerable thickness of

material is used, as in arches between floor beams, we doubt if in an ordinary building fire the depth reached would be sufficient to permit of collapse.

Yours respectfully,

(Signed) RICKETTS & BANKS.

Section built September 15, 1894; tested October 12, 1894.

Span, 5′ 6″, center to center of beams. Length of section, 5′ ¼″.

The above section was so arranged as to form the top of a furnace, and a load of 200 pounds per square foot was imposed on it and remained during the entire test. A hard wood fire was started at 12:40 P. M. and kept up until about 3:30 P. M., when it was extinguished by throwing water on it from a fire hose.

At the same time water was also thrown on the floor, and the composition did not crack, splinter off, nor did there seem to be any tendency to disintegration.

The surface of the section not exposed to the flames and the beams protected by the composition remained so cool during the test that the hand could be held on them without discomfort.

After the fire was extinguished the load was removed and a hole cut through the section, admitting of a thorough examination of the condition of the composition. The surface that was exposed to the flame was affected to a depth of about one-half inch, the remainder being uninjured, and the efficiency of the section to carry weight was apparently undiminished.

STRENGTH TESTS

TEST OF MANHATTAN FIREPROOFING COMPANY'S (NOW METROPOLITAN FIREPROOFING COMPANY) FLOORING, MADE AT THEIR YARD OCTOBER 2D, 1893.

The piece of floor tested was 9½″ wide, 4″ thick, and 5′ 0″ clear span between the wooden beams, to which the wires were firmly secured by staples, which prevented any slipping of the wires over the beams. Between the beams were timbers which prevented the beams from canting or being drawn together. The floor contained eight pairs of No. 12 wire, spaced about 1″ apart, and with a sag of about 2½″ at the center. The concrete filling below the wires consisted of plaster of paris and pine chips; the filling above the wires consisted of a concrete composed of two parts, by measure, of broken brick to one part of plaster of paris. The action of the floor under the different loads was as follows:

Load, Lbs.	Deflection, Inches.	Remarks.	Load, Lb., Per Sq. Ft.
7,600	. . . . .		1,900

The load was a uniformly distributed load, consisting of pig-iron, on top of which were placed bags of plaster of paris. The flooring gave way by the breaking of two wires on one side, close to one of the beams.

[COPY.]

CONSTABLE BROTHERS,
22 East Sixteenth Street,
NEW YORK, May 26th, 1896.

Superintendent of Buildings,
220 Fourth Avenue, New York City.

DEAR SIR: Having received a request from Mr. Hewitt to attend a test before the Board to-day, and a copy of a letter sent to them, I desire to make the following comments:

1st.—The Varick street tests were not made under the supervision of the Building Department, but arranged by Mr. Lindsey, who had four sample panels put in the building, and who requested

me to take charge on the appointed day, and the Department was asked to be present.

2d.—The drop tests showed the panels to be unusually tough and elastic.

3d.—The weight test was sufficient to show ample strength for such a building, but was not completely satisfactory, as the pig-iron was so uneven in shape that the pile toppled over before the ultimate strength of the floor was reached.

4th.—This accident interfered somewhat with getting complete data on the question of adjoining panels raising or buckling upwards if unloaded.

5th.—The first test consisted of burning, for an hour, what old wood and barrels could be collected around the buildings, and showed good results as regards fire and water, but was open to the objection that the plaster was still damp, and that the thermometer placed upon the beam did not reach more than 87 degrees, which was partly an indication that there was not enough volume of heat in proportion to the amount of material about it to either dry it out or make the test really a severe one. Recent experiments have demonstrated to me that most of the ordinary fire tests have been most uncertain as to real severity of the test, the very high temperature being up the flue.

The tests at Trenton showed about the same results, excepting the fire test was longer and the section of the floor loaded with brick, and the spans settled about 6", but again not quite as complete as could be wished, as the chip and plaster filling was damp and the iron tilted so that it could not be determined whether all the settlements of the arch was due to this or not.

I have recently shown you, by an accurate comparative test of the same material taken from the Varick street building, that there is an appreciable difference between testing damp and dry chip plaster. Under these circumstances, and as I have been recently quoted in the matter of this floor, *I desire to go on record that my opinion is that the floor is very strong and tough*, but as regards its qualifications in the matter of flexibility and fire resistance, etc., I do not wish to be quoted as giving unqualified approval.

Respectfully submitted,

(Signed) HOWARD CONSTABLE.

STRENGTH TESTS

RESULTS OF TESTS FOR STRENGTH OF METROPOLITAN FIREPROOFING COMPANY'S FLOORS

Date	Distance between beams, center to center	Length of section tested.	Area tested in square feet	Total load applied, in pounds	Load per square foot, in pounds	Remarks
	Ft. In.	Ft. In				
May 1, '95	7 0	2 6¼	16.48	18,151	1,101	Failed by deflection and adjoining arches lifting. No wires broken.
May 1, '95	6 0	2 6⅛	14	18,891	1,350	Failed by deflection and adjoining arches lifting. No wires broken, but outside beams bent about 1 inch.
May 2, '95	5 6	2 6	12.68	14,076	1,110	Failed by deflection and adjoining arches lifting. No wires broken.
May 2, '95	5 6	2 6	12.68	14,076	1,110	Failed by deflection and adjoining arches lifting. No wires broken.
May 2, '95	5 6	2 6⅛	12.71	16,526	1,300	12 wires, 2½ inches apart. Failed by all the wires breaking close to beam on east side.
Aug. 12, '95	7 0	2 6½	16.64	17,660	1,061	Heavy rain storm Sunday night. Arch not protected. Tested following Monday. Failed by deflection and adjoining arches lifting. No wires broken.
Aug. 21, '95	8 0	2 6	18.88	16,265	861	Failed by deflection and adjoining arches lifting.
Aug. 21, '95	6 0	2 6½	14.08	18,710	1,328	Failed by deflection and adjoining arches lifting.
Aug. 22, '95	5 6	2 6½	12.87	17,845	1,386	Failed by deflection and adjoining arches lifting. These arches were built between 15-inch beams, without skewbacks.
. . . . .	. . . . .	2 0	10.667	5,923	555	This test was made in Baker Building, Philadelphia, Pa., and was part of permanent floor. Not tested to destruction.
. . . . .	5 10½	2 0	11	8,782	798	This test was made in Baker Building, Philadelphia, Pa., and was part of permanent floor Not tested to destruction
Dec. 12, '95	5 6	0 32½	13.74	11,110	809	Not tested to destruction.
April 24, '96	5 6	2 6	12.63	9,510	753	Not tested to destruction.

IMPACT TESTS

Section built September 15, 1894; tested October 12, 1894.

Span, 3′ 9″, center to center of beams.

Length of section, 5′ ¼″.

The weight was cylindrical, $9\frac{1}{4}$ inches diameter, and weighed 205 lbs.

A board 1″ thick was placed on the center of a section parallel with the beams and the weight dropped on this board.

Height of Fall.	*Effect.*
2′ 0″	No visible effect on the section
4′ 0″	No visible effect on the section
4′ 10″	No visible effect on the section

The board was then removed and the weight allowed to fall 5′ 0″ on the unprotected composition, striking each time on a different place. The weight did not fall squarely, but on edge, and cut each time into the composition. In those cases where the edge of the weight reached the wires it spread them apart, and *in no case were any* of them *broken* under this test.

A board 1 inch thick and 1 foot square was placed in the center of the section adjoining the one on which the test described above was made, and the same weight allowed to fall 5′ 0″, each time striking in the same place.

The first blow broke the board. The second blow so shattered the board that it could not be used again. The third blow was on the unprotected composition, and the edge of the weight cut into it.

On dropping the fourth time the weight cut into the composition to the wires, leaving them bare. The fifth blow broke or cut the wires (the weight falling each time on edge), and the weight dropped through the floor.

The wires were continuous from section to section, and the breaking of the wires in this section did not affect the portions of the same wires in the adjoining section, which had been laid bare in the first impact test.

The hole in the floor was rather clean-cut and very little larger than the weight.

Section built April 15, 1896.

Tested April 24, 1896.

Span, 5′ $5\frac{5}{8}$″ center to center of beams.

Length of section, 2′ 6″.

Cylindrical weight of 205 pounds.

Height of Fall.	*Effect.*
4′ 0″, 1 blow 5′ 0″, 2 blows 4′ 6″, 6 blows	At the ninth blow, two wires were broken and weight went through floor.

Indestructibility By Water

Composition Not Affected by Water

That the composition, as used in construction, is not injured by water is demonstrated by the fact that no injury to it is caused by storms occurring while it is being put into floors of buildings not covered in, as well as by special tests. In one case on one section was placed a load of 330 pounds per square foot, the adjoining section being left without load in order to determine whether or not the cables would pull through the material when saturated with water. Water was allowed to flow on the material for 24 hours, and no apparent weakening of the composition was produced. In another instance a plate of the composition, about 1′ square, was entirely submerged in water more than 70 hours without showing any tendency to disintegrate. Immediately after the plate was taken from the water it was placed on top of the cables and a load of 800 pounds per square foot placed upon it. Under this load the plate gave no indication that its breaking point had been reached, nor did the cables cut into it.

Effect of Soaking in Water on Wires and Block

Block, 4″ by 12″ by 14″, with wires, made June 27th, '94.

Put to soak in water September 11, '94.

Taken out of water October 3d, '94—22 days in water.

Put to soak in water 10 A. M., January 14th, '95.

Taken out of water 10 A. M., January 15th, '95—24 hours in water.

Put to soak in water 2:30 P. M., April 12th, '95.

Taken out of water 5 P. M., April 15th, '95—74½ hours in water.

Put to soak in water 9:30 A. M., May 18th, '97.

Taken out of water 9:30 A. M., May 19th, '97—24 hours in water.

Block was not injured by soaking in water.

Wires imbedded in the plaster bright and clean.

Non-Corrosive

Effect of Plaster on Wire

The following letter, regarding the effect of plaster on wire imbedded in it, is from Mr. John Rogers, the well-known designer and manufacturer of the "Rogers Groups" of statuary:

New Canaan, Conn., March 13th, 1895.

Dear Mr. Ketchum: Your letter of inquiry about the effect of plaster on wrought iron imbedded in it is just received. I have broken up plaster casts that have had iron imbedded in them for years, and found no bad effects at all after the first rusting from the damp plaster. While the plaster is still wet it will, of course, rust the iron, but as soon as it is dry it will have no effect on the iron whatever as far as my experience goes. I strengthen my moulds, which last for years, with irons, and on breaking them up to make new ones I invariably use the same irons over again.

Yours truly,

(Signed) John Rogers.

Extract from the report of Peter T. Austin, Ph. D., F. C. S., Expert Chemist:

"The action of the composition on iron is as follows: The plaster, in setting, chemically absorbs most of the water, the rest being evaporated in a short time. During the setting of the plaster a film of oxide of iron is formed on the surface of the iron, which assists the contact between the iron and the plaster by roughening the surface of the former. The mass, acting as an insulator, protects the iron from oxidation, making it permanent. No gases are generated. Its action in contact with steel is practically the same."

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